# A
# Perpetual and Vniverſal
# ALMANACK

Compriſed in a moſt Compendious Table, exhibiting with great dexterity, all Moveable *Feaſts* and *Terms*, with other the Common Notes in both Accounts; the Change of the *Moon*, the Day of the Week correſponding to the day of the Month, and the contrary: All which are again indigited by an Artifice Arithmetical, very feaſable to the meaneſt Capacity, and never before publiſhed.

TOGETHER

With a large Appendix, comprehending the moſt neceſſary Propoſitions in *Aſtronomy* and *Coſmography*; reſolv'd as by briefe and generall Tables, ſo by *Trigonometry*; the Principall Heads of which are inſerted in the next following Page.

*Compoſed* for the benefit of Sea-men and Travellers, and commended as uſefull for all.

BY JOHN CATLETT.

*Semper vireſcit, nomen virtute partum, nunquam ſeneſcit*

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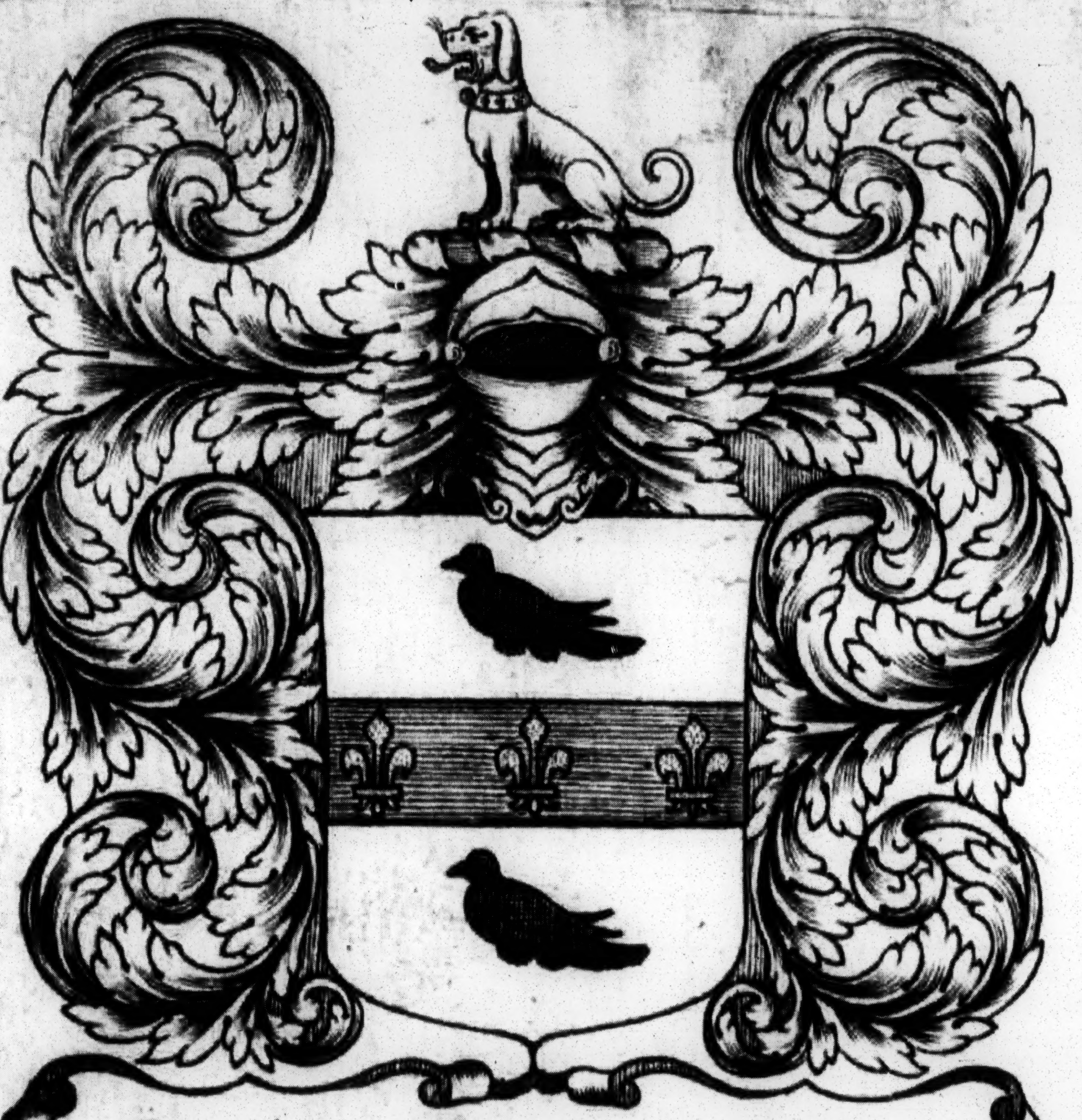

*Iames Huſtler of Acklam in*
*Cleveland in the North Riding of*
*the County of Yorke Esq.$^{r}$ 1780*

## *A Table directing to the Heads of the Perpetual Almanacke.*

*He univerſal and perpetual Almanack explained,* Chap. 1
*To find the Circle of the Sun and Dominical Letter, by inſpection,* Chap. 2. *By Arithmeticke,* Chap. 7
*find the Golden Number and Epact* Chap. 3. 8, 9
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*find the day of the week anſwering to the day of the Month, ad contrariwiſe, the day of the Month, if forgotten, by inſpection,* Chap. 6. *By Arithmeticke,* Chap. 11
*find the day of the Month in which any Moveable Feaſt ſhall pens;* Chap. 4. *By Arithmeticke,* Chap 12
*find the time of High-water in all thoſe places inſcribed,* Chap. 13

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## *The Principall Heads in the Appendix.*

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*To adde Aſtronomical Fractions,* Chap. 2
*ſubſtract Aſtronomical Fractions,* Chap. 3
*find the proportional part,* Chap. 4
*calculate the true place of the Sun,* Chap. 5
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*ll the proceeding and divers other Propoſitions in Aſtronomy, performed by Trigonometry,* Chap. 12
*opoſitio Geographical applyed to many neceſſary queſtions in Navigation,* Chap. 13

*fter which followeth a Table ſhewing the 32. Rumbs, and Catalogue of many eminent places with their Long. and Lat.*

# *Courteous* READER.

IT is not more cuſtomary, then many times neceſſary, to entertain the Reader with an Epiſtle previous to the deſigned ſcope: in this, without further preamble I ſhall only adde one premonition in reference to that vulgar rule hereafter inſerted, To finde the change, and conſequently the age of the *Moon*: the operation of which I commend not to thee as conſentaneous to *Aſtronomical* computation: For I am not ignorant that ſo great variety of motions obſerved in her Gyre, are impoſſible to be reduced into any one Canon, that may fitly acquire the name of a Compendium: yea this, in ſucceeding Centenaries will be more irregular, if not corrected by ſome vulgar æquation, and that becauſe the extraction is from a fallacious ſuppoſition of the Ancients, who thought that in the Revolution of nineteen yeares, all Lunations, *viz.* New, full, and quarter *Moons*, returned to the ſame time againe: but by the more exact examination of our Modern Obſervators, there is deprehended in that Intervall, the anticipation of one hour and thirty minutes, which in the circumvolution of ſixteen Lunarie Circles, diminiſheth for future years a day civill, and this indifferently from the time now given: the which however ſometimes a day differing from the truth, is ſufficiently uſefull in all common and ordinary operations, as fully appeareth by the ſequell of thoſe queſtions relating to it; amongſt which, thou mayeſt happily meet with ſome worth thy noting; but if beneath thy more acute ſpeculations, ſhew thy ſelfe ſo far a friend to Art, as to commend it to the leſſe diſciplin'd: In ſo doing thou wilt not only proſecute the principal deſign of the Author, but very much oblige him.

*Sittingborn* in *Kent*
*Septemb. 4. A.C. 1656.*

**Thine in all civill**
**Courteſies**
***Jo. Catlett.***

# *In Laudem Operis & Authoris.*

TO be perſpicuous, and yet briefe, to ſome
May ſeem a Pradox, yet *Reader* come
And with an equall and judicious mind,
Firſt read it o're, then judg as you do find.
I think I need not highly to commend,
What here the Author to your view doth ſend;
Each Man that reads I do ſuppoſe will be
To give this book its worthy praiſe, moſt free.
And with me alwayes wiſh him good ſucceſſe
In his imployments, and true happineſſe.

*Tho. Catlett.*

# To the Author in commendation of of his perpetual and univerſal Almanack.

THe World's orbicular; time wheels about,
And in this order thou haſt ſet them out
An Almanack for ever, ne'r's out of date;
Nor ſhall thy fame by times devouring fate.
Bleſ'd paines! that once for all hath undertook
To make, (for each year one) one onely Book:
Wherein, ſo many Arts thou doſt diſcover
That he who loves the Arts, muſt be thy lover.

So is *J. H.*

# Ad Lectorem: In laudem Authoris, qui annis adhuc juvenilibus, bis dignis Patriam oppido ditavit ſtudiis.

I ingenio pollens ſublimi, hic Author, & Arte
O omnigenâ, Mundo protulit iſtud opus.
H hujus & Inventor primus, non tramite trito eſt
A agreſſus; Lector! non aliena tulit.
N noſter & Aſtrologus, procul occultatia ducit
N nobis: atq; novas invenit ille vias.
E ecce dedit cœli motus, Lunæq; meatus
S ſtellarum numeros: plurima multa ſimul
C compoſuit, Tabulis (ut Homeri verſus) in arctis:
A annos includens annulus ecce tibi eſt.
T trigonam, Topicam, Nautalem condidit Artem.
L libros quam plures continet iſte Liber?
E ergo favere viro fas eſt; qui deniq; faſtos
T tradidit æternos: cui ſit in æva decus.

**Jo. Hurt Sittingb.**

To

# To the READER

## In praiſe of the Authors moſt ingenious, compendious and perpetual Almanack.

INgenious Wits, ſuch as this Author's is,
Doth much inrich the World with rarities.
Loe here, the univerſe he doth inrobe
O-happy genius ! thus to comprehend
All time, untill all time ſhall have an end !
Be ſilent then you former Ages which
Have of your rare Inventors boaſt'd ſo much
Suppoſe *Milecius* might the *Gnomon* find,
And firſt the *Suns* and *Moons* Eclipſes mind ;
Or *Atlas* firſt invent the Sphears ; (wherefore
'Tis fain'd on's ſhoulders he the Heavens bore)
*Endymion* firſt ſhew'd how the *Moon* doth move,
Hence Poets fain, with him ſhe fell in love.
*Cleoſtratus*, *Pythagoras* and *Theon*,
*Maugantius*, *Mevin*, *Maccius* and *Melon*,
All theſe and many more that might be nam'd,
Were in their Generations truly fam'd.
And hath not this new Author done as well
That hath compriſ'd as much within a ſhell ?
Therefore for his perpetuall Almanack
Perpetual praiſes let him never lack.

*J. H.* ibid.

# In Librum conatu honeſto, laudabiliq; ingenio contextum.

COmputus ut regitur, geſtis neſcire dierum ?
Quid Solis nitidi Cyclus, quid Cynthia conjunx
Sic quem deſcribit ? Poſthac, quæ digna notatu,
Contineant ambo ? Numerum qui præterit anni,
Quâ ratione queas certò cognoſcere, Lector,
Circulo in hoc gemino ? tibi ſerviet iſte libellus.
Parvus, at & magnus; parvus volumine, magnus
Vſibus, hoc poſito, formâ quò peſſior ille,
Hoc major. Socum, ſed nec, mihi ſupputet, uſus
Eſſe animum cunctos, verbis numerare ligatis,
Vllus, (nec opus eſt) : potiora intacta reliqui ;
Vtpote, qui tenui donatus arundine, verſus
Pro meritis, non ſim moderalier aptus, amici :
Allubuit ſedenim, de multis tangere paucos.
Vos cum fluctivagi qui optatis carbaſa ventis,
Quî teneatis iter curvata trabe per undas,
Quas facit ignotas virides, diſtantia, terras,
Vt per luſtretis rationem tradidit Author.
Aurifero huic etenim poſuit problemata fini :
Texuit & tabulas varias conamine miro,
Dexteritas, ſpatium, fælix, quas egit in arctum.
Parcitur his æri, longo & (tentate) labori.
Pergite, & à terris quantum, ſi forte velitis,
(Quâ valet arte docet) removentur, ſcire, vapores.
Sed neq; diſpliceat, rigidi ! ſic ſeria ludo,
Quòd ſubiit mentem lepidam, conjungere magna.

*Nam quis, ab exiguis anſis, prudentior unquam*
*Inficias ibit, munus quin grande petatur ?*
*Præterea hoc quid ſit, noſtis ; tulit omne momentum*
Utilibus novit, quiſquis ſua dulcia ferre.
*Huc ades, & tu cui placet ars, quæ ſpectat ad umbras :*
*Quem Geometra juvat ſolers audire, venito ;*
*Apta tuo capias genio. Quò deniq; plures*
*Sint meritæ laudes, duplex monſtratur ab illo*
*Semita : conſuluit variis ſic viribus, omnes*
*Diſcant : & docti qui ſe coluere per artes,*
*Indocti paritèr : numerando ſcilicet illi*
*Fortaſſis gaudent, proprio quoq, Marte repertis :*
*Quærere quod vellint, hi delectantur ocellis.*
*Inſuper, ut quævis fiant, ex parte, beata*
*Munera, quæ miſit mundo ; cùm contigit error*
*Annorum curſu, vigilanti quomodò tollat*
*Obtulit hunc. Fructus quales fæcundior hortus*
*(En guſtum ! ) profert ? ietatis, porta recluſa eſt.*

*Hos qualiſcunq;, amicitiæ junctiſſimæ*
*τεκμήριον, adſcibi curavit, verſus*
*G. I.*

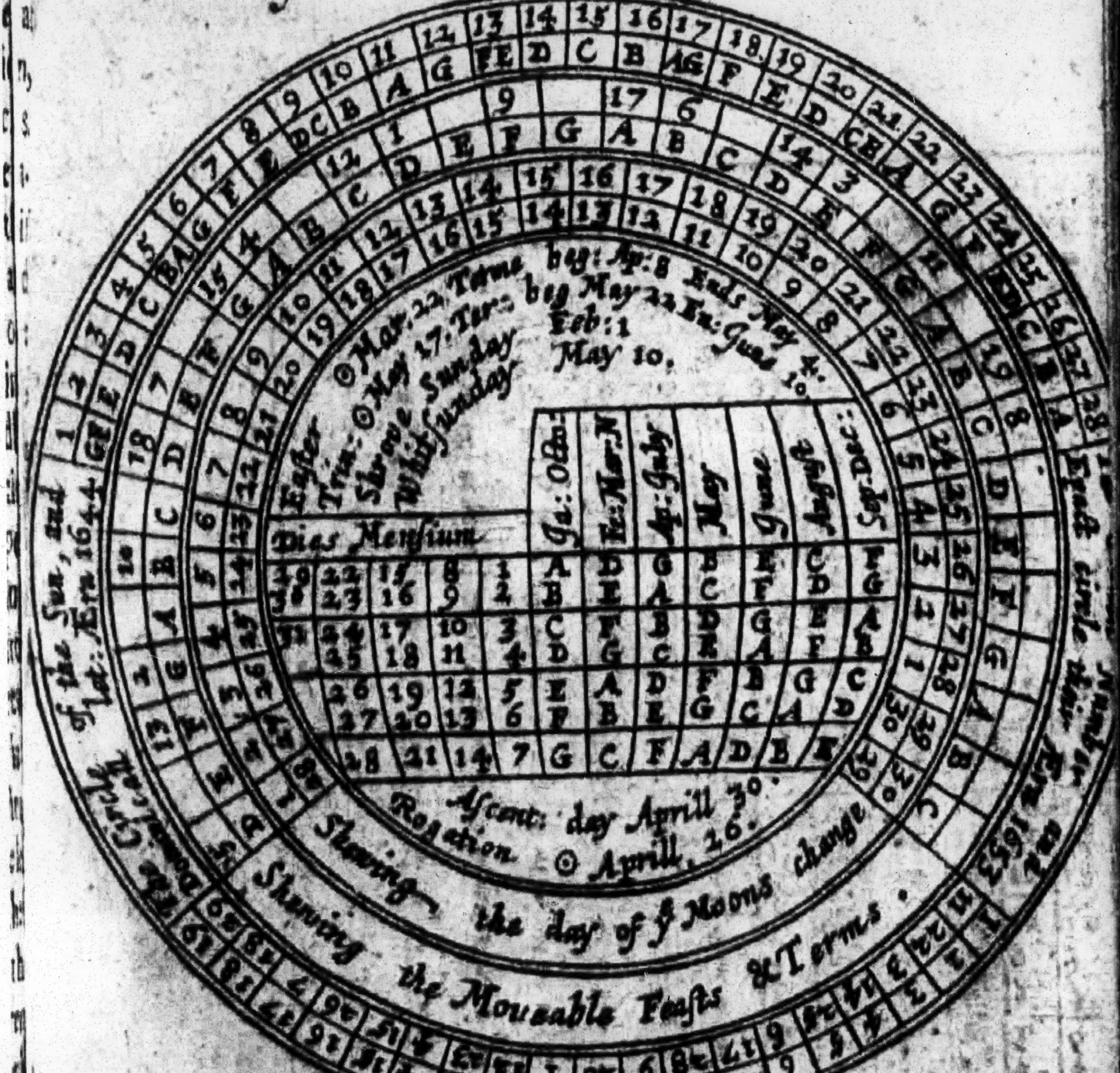
**Of**

# Of the Revolution and diſtribution of time, into Years, Months, Weeks, Dayes, Hours and Minutes.

THE practice of all Nations, how ignorant ſoever in Aſtrological Sciences, have unanimouſly granted, that the Heavens by their orbicular motions, diſtinguiſh times and ſeaſons, a thing as obvious to obſervation (*humani generis*) as the properties of other created beings. But not to detain you with impertinences, I ſhall haſten to the matter intended, where it muſt be noted that time is conſidered, *quoad partes majores & minores*. The greater parts of time are ſaid to be a Year, Month, and a week, every of which, *eadem ſpecie*, as different in their dimenſions as the motions of that ſubject from whence denominated, and this *Solarie* or *Lunarie*; the Solarie yeare determined by the Suns motion is twofold, Tropical or Siderial; a year Tropical is the Interval of time, in which the Sun moving from one Tropick (or known point) returneth to the ſame again. In which ſpace the Sun meaſureth by his perambulation (according to the lateſt obſervation) 365. dayes, 5. hours, 49. minutes, 4. ſeconds. Hence it is evident that the *Iulian* year (ſubſtituted by *Julius Cæſar* 44 years before the Nativity of our Saviour Chriſt) conſiſting of 365 dayes, 6 hours, exceeds the true year 10. min. 56 ſeconds which exceſſe ſince the firſt eſtabliſhment of the *Iulian* year hath much varied the time, not only of the Paſchal celebration, but alſo the Equinoxes being now receved from their Priſtine ſight in the time of *Cæſar* 13 dayes; upon this ground Pope *Gregory* the thirteenth, to reſtore all things to their places at the time of the Nicene councell, *Anno* 322. (the Equinox being then upon the 21 of *March* ordained that ten dayes ſhould be omitted in the Month of *October*, 1582. whereby the fifth day of the *Iulian* muſt anſwer the fifteenth day of the *Gregorian* account, and this difference to continue to the 24 of *February*, 1700. from which time the *Gregorian* year is to exceed the *Julian* eleven dayes; ſo for the future every four Centenary (including the year 1700.) to be Intercalary: but the other Centenaries common, every year conſiſting of 365 dayes. Hence it cometh to paſſe that every 400 years ſhall gain 3 dayes of what the *Julian* year loſeth; and whereas there is mention of a year common, it muſt be noted that the *Julian* year is either Common or Biſſextile; the firſt containing 365 dayes, the latter 366 dayes, which happeneth by reaſon that the ſix hours above recited, being omitted in the Common year, amounts to one day every fourth year, to be inſerted in the Month of *February*; hence three years are called Common, but the fourth Biſſextile or Leap-year, ſo named becauſe the ſixt Kalends of *March* (which is the 24 of *February*) by means of the ſuperadded day, is twice to be reckoned. And this is the account obſerved throughout great *Brittain* and ſome particular places beyond Sea; but in the parts of the *Romiſh* correſpondence, the forementﬁon, called the *Roman* account, and *Novo ſtilo*; a year Syderial, is the ſpace of time in which the Sun departing from any fixed Star, returneth to the ſame again, to performe which he requireth 365 dayes, 6 hours, 9 minutes, 22 ſec. The Lunarie year is alſo Common or Emboliſmal; Common, is the interval of time in which the Moon is twelve times ſynodically joyned to the Sun, and containeth 354 dayes and certain hours. Emboliſmal is intercalarie, and comprehendeth thirteen Lunarie Conjunctions, compleated in the ſpace of 384 dayes, or thereabout: the firſt is leſſe then the common Solarie yeare by eleven dayes, which difference is called the Epact, to be added ſucceſſively to the common Lunarie year untill the increaſe ſhall conſtitute the dayes of the thirteenth Moon which happeneth every third yeare, for which cauſe called Emboliſmal, or if you pleaſe the Lunary Leap-year, and exceedeth the common Solarie Year by nineteen dayes; Moneths are alſo Solarie or Lunarie again, the Solarie moneth is either equall or unequall: Equall is the Suns progreſſe from one Signe to another, finiſhed in 30 dayes, 10 ho. 54 m. *ferè*, and this according to his equated motion, being ſometimes the ſame, at other times more or leſſe then the equall motion, uſuall as they are diſtributed in our Almanacks. Lunarie, is the ſpace in which the *Moon* itenerateth through the twelve Lignes of Zodiack; this threefold; firſt, Periodical or Peragration, and is the time in which the *Moon* paſſing from one point of the Zodiack returneth to the ſame againe, containing 27 dayes, 7 hours, 43 min. Secondly, Synodical, the time in which the *Moon* departing from the *Sun* returneth to him again, and is performed in 29 da. 12 ho. 44 min. Thirdly, Illumination, or Apparition, the interval of time from the firſt appearance of the *Moon*, to her laſt farewel and containeth about 28 dayes. A Weeke is the ſpace of ſeven dayes; this God inſtituted in the diſtinction of the works of Creation; the leſſer parts of time are a Day, Hour, Minute, &c. the firſt is either Civil or Natural. A day Civil is the revolution of the whole Equator, and moreover, ſuch a part as the *Sun* in that period meaſureth by his equall motion, the whole time being reckoned for 24 hours: Naturall, is the continuance of the *Sun* above the Horizon, and admitteth of as many dimenſions as there are ſeveral verticals. An hou is equal or unequal; equal, the 24 part of a da

civil

In se conuertitur annus .


Easter ☉ Mar. 22 Terme beg: Ap: 8 Ends May 4.
Trin: ☉ May 17. Term beg May 22 En: June 10
Shrove Sunday Feb: 1
Whitsunday May 10.
Dias Mensium
Ja: Octo:
Fe: Mar: N
Ap: July
May
June
August
Sep: Dec:
Ascent: day Aprill 30.
Rogation ☉ Aprill. 26.
Shewing the day of ye Moons change
Shewing the Mouable Feasts & Terms .
Circle of the Sun, and Dom: Let: Æra 1644
Epact circle
Æra 1653

Place this Ocular Almanacke to open with the booke at the end of the 1. Chap: explaying its vse .

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civill; unequall the 12 part of a day naturall, theſe hours vulgarly called Planetary, increaſing or decreaſing in proportion to the day of which they are apart; of theſe dayes and hours our Saviour ſpeaketh in the tenth Chapter of St *John*; *Nonne 12 horæ ſunt diei?* to which muſt be referred whatſoever is written (concerniug dayes and hours) before the 300. yeare of Chriſts Nativity, for unto that time the Ancients had them in uſe, and ſo of the night; a Minute is the 60 part of an hour; a Second the 60 part of a Minute, and ſo *ad infinitum.*

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## Chap. I.

### *Sheweth the Explanation of the Perpetuall and Univerſall Almanack.*

IT conſiſteth of ſix circular Collumns or Zones, together with a Compendious Table, environed by the former Circles, to the middlemoſt of which is ſubſervient the day of the loweſt falling of thoſe moveable Feaſts and Terms, inſcribed over and beneath the ſaid Table; every one of which uſefull as followeth.

The two firſt compaſſing all the reſt, exhibite firſt, in the ſuperiour part the number of the *Suns* Circle, and Dominicall Letter, to which is prefixed the year of our Redemdtion 1644. the common term from whence to reckon all ſucceeding years; ſecondly, in the lower part the Golden number, and Epact, both beginning at the year 1653.

The other two, contiguous to the foreſaid Columns, do accurately indigit all ſuch moveable Feaſts and Terms, whoſe loweſt falling is known, and ſuppoſedly annexed to the firſt ſpace in the peculiar Column.

The two next and leaſt, with much facility direct to the day of the *Moons* change, and conſequently her Full and age.

Finally, the incloſed Table conſiſting of 12 Columns ſheweth with great dexterity; firſt, the day of the weeke correſponding to the day of the Month: ſecondly, the day of the Month, if the age of the Moon be given or ſuppoſed within three dayes and a halfe, over or under her true age. Theſe premiſed, I deſcend now to particular inſtructions in their ſeverall applications.

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## CHAP. II.

### *To find the Circle of the Sun, and conſequently the Dominicall Letter.*

IN the Circle prenoted to this uſe, reckon the Year of our Lord from the appointed term incluſively given to the firſt place, accounting every next for one year, untill you ſhall accompliſh the number of years required; the ſpace of which extent will manifeſt the number of the Suns Circle, and next under it the Dominicall or Sunday letter, or letters, as it happeneth every Leap-year, of which, the firſt ſerveth from the beginning of *January* unto the 24 of *February*, (the indiciall Letter whereof ſerveth alſo for the 25 day: hence *Annus Biſſextilis* as aforeſaid) the other from thence excluſively unto the years end. But if it happen that the ſupernumerary years exceed the number of ſpaces, which are in all but 28. place the year following that in the laſt partition, upon the firſt ſpace, and then proceed as above. If the years of our Lord precede the appointed term, number the years and ſpaces in a Retrograde order, calling the laſt 1643. the next 42, &c. To conclude, if the queſtion be for the Forraign account, inſtead of 1644. place 1652. whileſt the difference of accounts remaineth 10 dayes, but when 11 then 1653, &c. *Terminum aquo.*

To facilitate this Precept admit *Anno*, 1657. it be required to find the premiſſes: placing 1644 in the firſt ſpace, call the next 45, the next 46, &c. untill you have numbred 57, which laſt you ſhall find determined by that ſpace, wherein is inſerted 14 the circle of the Sun, and underneath D. the Dominicall Letter; but for the *Roman* account 6.

## CHAP. III.

### *To find the Golden Number, and Epact.*

DIrecting your eye to the lower part of the precedent Circle, you may behold 1653, the term or *Æra* to the reſpective Circles, that for the Golden Number beginning at 1. and numbred to 19. the other at 11. and ending at 29. wherefore according to the forementioned order, ſuppoſing that 1653. ſtandeth in the firſt place, account the next 54. the next 55. &c. untill you have numbred the years given; and the ſpace concurring with the period of the ſaid years ſhall ſhew the Golden Number, but the ſpace anſwering in the other arch, the Epact; but if the years exceed the number of ſpaces, or are precedent to the term given, conſult the laſt Chapter in the like caſe. The golden number in the *Roman* account is the ſame with the *Julian*, but the Epact is alwayes leſſe by 10 dayes whileſt the difference of accounts doth not exceed.

Finally, the Dominical Letter and Golden Number begin the firſt day of *January*, but the Epact the firſt of *March*: for further ſatisfaction, admit that to the year 1657. it be required to find the foreſaid numbers; to this end ſuppoſe the firſt ſpace 1653. the ſecond 54. and ſo on to 57. which number will convene in the fifth ſpace, by which is ſignified the Golden Number, to which is ſubjoyned 25. for the Epact, but 15. for the *Roman* account.

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## Chap. IV.

### *To find the day of the Month in which any Moveable Feaſt or Term ſhall happen.*

BY the two precedent Chapters get the Dominical letter and Golden number to the year given; with the Golden number enter the third Column, which noted in its proper place, note alſo in the next Column towards the Center your Dominical Letter, being the ſame which followeth next after the place of the Golden number (alwayes excluding that which anſwereth to the Golden number) then place the loweſt falling of the Feaſt or Term deſired in the firſt ſpace, let the ſecond be one day more, the third another day, ſo continuing the progreſſion untill you have numbred the prenoted ſpace of the Dom. letter, conſider whether the Sum paſſe the number of dayes in the Month wherein is the loweſt falling of the Feaſt deſired; if more, deduct the dayes of that Month, and reckon the reſidue in the dayes of the enſuing Month, and you have the day ſought. Note when two Dom. letters offer themſelves, (which is every fourth year) the firſt directeth only to thoſe Feaſts, whoſe falling is not more then the 24 day of *February*, the other for the time after.

Noting alſo if a Feaſt happen between the 29 day of *February* and the 22 of *March* both being excluded, reckon the day found one day more, *viz.* in the Leap year as aboveſaid: in the *Roman* account (whereas in the *Julian* account you noted the given Dom. letter, which was firſt after the golden number) note the Dom. letter for the year, the ſecond after the golden number, then proceed as above. To make the rule more obvious; ſuppoſe that in the year 1657. you would know the day that *Eaſter* will fall upon; by former operations the golden number is found to be 5, the Dom. letter D. therefore applying your eye to the Circle peculiar to this uſe place *March* the 22. (noted over the Table to be the loweſt falling of *Eaſter*, thus, *Eaſter* ⊙ *March* 22.) in the firſt ſpace, and ſeeking the Golden number 5. you have it inſerted right over the firſt ſpace in the Circle of Dom. letters, which becauſe the firſt call the 22 of *March*, the next the 23. the third the 24. and ſo forward unto D. (that being the Dominical letter, and the next after the golden number) the number of which ſpace ſhall aſſign the 29 of *March* for *Eaſter* d. but to the *Roman* account the firſt of *April*.

## CHAP. V.

### *To find the day of the Moons change and conſequently her full and age to any Month of the year propoſed.*

HAving obtained the Epact by Chap.the third ſeek it in the penultimate Column towards the Center, and that ſpace aſſigned to it, evermore call *March*, (it being the Month when the Epact beginneth) the next ſpace in a direct ſeries, call *April*, the third *May*, &c. until you come to the Month wherein you ſeek, and the ſpace determining the Month, next under it, ſheweth the day of the change, to which adding 14 dayes, 18 hours, there is given the full; but if you ſeek the Epact in the Column next the center, number the Months contrarywiſe, proceeding towards the left hand; here note, if the Epact in the ſubſequent year ſtandeth in the place of *February*, account the day of the change in *February* leſſe by one, except it be Leap-year. Again, when the change falleth upon the firſt day of any Month, you muſt count the next ſpace the thirtieth of the ſame Month. I adde moreover, if the change be required for future Ages for every 304. years, reckoned from the beginning of this preſent Century it is neceſſary that you ſubſtract one day from the time found, but contrarywiſe adde one day if required to the precedent Ages, which done, you have the time indifferently diffently corrected for this vulgar ſupputation. For your practice I will ſubjoyne an Example or two, *An.* 1657. in *Sep.* let it be demanded to find the day of the change; to this year the Epact as above is taught is 25, which noted in the penultimate Column, you ſhall find under it the 4 day of *March*, the next ſpace towards the right hand the third of *April*, and until you come unto the ſpace for *September*, wherein is inſerted 27. that being the day of the change required: again, in the ſame year let it be required to know the change in *February*; now becauſe the former Epact taketh not place until the firſt of *March*, you are to find it to the precedent year, of which *January* and *February* are the two laſt months, which obtained as before is 14, this noted in the proper Circle, call the ſpace under it the 15. day of *March*, the next, the 14 of *April*, and ſo forward in a direct courſe, untill you come to the ſpace determining the Month of *February*, in which is inſerted 4. but becauſe it chanceth in the place of the next Epact, call it 3. as aboveſaid. Hence I conclude that the *Moone* changeth upon the third day according to the vulgar reckoning, and is ſufficient for ordinary uſe.

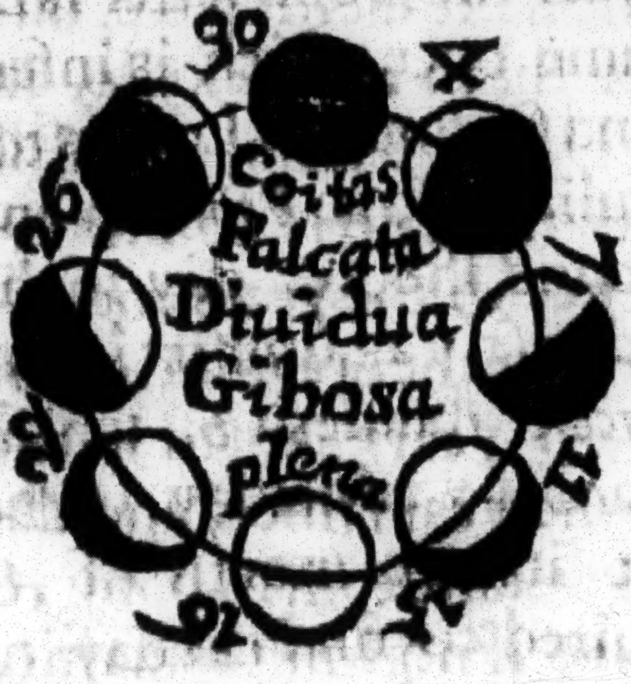
## CHAP. VI.

### *To find the day of the week anſwering to the day of the Month in any year aſſigned, and contrary-wiſe, to finde the day of the Month, if forgotten.*

HAving already prenoted the proper Table for this uſe; by the ſecond Chapter enquire the Dom. letter to the year aſſigned, the which note in that collumn to the front whereof is affixed the given Month ; again in one of the five left hand Columns note the day of the month given, againſt which in a direct line anſwereth a Dom. letter inſerted in the foreſaid Column of letters, the place whereof numbred from the Dom. letter, (by calling the Dom. letter Sunday, the next deſcending munday, &c.) ſhall manifeſt the day of the week ; if the year be Biſſextile the firſt Dom. letter ſupplyeth this uſe from *January* to the 24 day of *February*, but the latter for any day ſucceeding.

Contrarywiſe, to know the day of the Month, is required ; firſt, by the former Chapter to find the day of the change : ſecondly, by ſuppoſition, or anocular obſervation of the *Moons* face to collect her age (and the better to inform your judgment herein, I have ſubjoyned a Scheam of her Illumination) this added to the day of the change, the Sum if not more then the dayes in that Month (in which caſe ſubſtract the ſaid dayes) giveth the ſuppoſed day of the month, with which entring the Table after the former manner, and it correſpond to the day of the Week given, you may aſſure your ſelfe it is the true day ; otherwiſe direct your eye to the day of the week, and in a right line againſt it note the ſeverall dayes of the Month, of which the neareſt to the day ſuppoſed (ſo it differ not above three dayes) is the verifi'd day of the Month ; If at any time the difference exceed 3 dayes you may conclude an error in gueſſing at the *Moons* age, in ſuch a caſe the Rule faileth: for a more cleare demonſtration of what I have ſaid, it will not be impertinent to ſubjoyn an Example to each queſtion, briefly thus, *Anno* 1657. to the 25 day of *March* it is required to know upon what day of the week it falleth. To this year the Dom. letter is D. which note in that Column over which is inſerted *March*, and is the ſecond Column of Letters towards the right hand, peculiar alſo to *February* and *November*; and having found the 25. day in the Columns of numbers, directly againſt it in the Column aſſigned to *March*, ſtandeth 6. which reckoned from D downward is wedneſday. In the other example admit that in the month of *April Anno* 1657. it be required to find the day of the Month agreeing to a certain Saturday, upon which by inſpection of the *Moons* ſhape compared with the following Scheam, you conjecture her age may be 10 dayes, this added to 3, the day of her change found as above, the aggregate is 13. by ſuppoſition the day of the Month. For more certain proof, enter the Columns of numbers with the 13. day, against which in the Column entituled *Aprill, July*, ſtandeth E. the indicial letter for munday as before is taught, but the day given is Saturday, wherefore directing your eye upon C the Saturday letter for this year, oppoſite thereunto in the forementioned Columns ſtandeth 4. 11. 18. 25. now in regard 11 is the neareſt to 13 the day ſuppoſed, and not differing more then 3 dayes, you may be confident that that Saturday in which the queſtion was moved is the eleventh day of *April.*

## *A Scheam of the Moons Illumination*



Having hitherto explained the parts of an Ocular Almanack; it remaineth now that we indigit the ſeveral uſes by Arithmetick, whereby every Aſtrophile *ſine libro*, may with great facility reſolve any queſtion within the limits preſcribed the moſt principall of which, were never before publiſhed.

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## Chap. VII.

### *Of the Circle of the Sun and Dominical letter, with the order of finding them Arithmetically.*

THe Circle of the Sun, ſo called in reference to the Suns revolution, which reckoned 28. being ſo many years, cauſeth the Dom. letter, and conſequently the day of the Week, to return as in a Circle to the ſame day of the Month, to which it did correſpond in the firſt of thoſe 28 years: the period of this Circle Antiquity hath placed at the firſt of *January*, from whence ſucceſſively are numbred 7 dayes, to which in the ſame order are appropriated 7 Alphabetical letters, indices to the dayes of the week; for if any one be aſſigned the Dominical or ſunday letter, the next in direct order ſhall denote munday, the next tueſday, &c. unto the end of the year, except in a Biſſextile, in which are appointed two Dom. letters, the firſt in reverſe order is uſed unto the 24 day of *February*, and the other from thence to the years end.

To find the lapſed years in the revolution of the Suns Circle, adde the *9* years lapſed in the year of Chriſts nativity, to the years ſince, and dividing the Sum by 28, the remainder ſhall point to the number of years paſſed; if nothing remaine, then 28. is the Circle of the *Sun*; thus in the year 1657. the Circle of the *Sun* is 14, for the aggregate of 1657 and *9* is 1666. which divided by 28 leaveth 14, the number required.

To find the Dom. letter, divide the Complement of the Circle of the *Sun* to 29 by 4, and that quotient added to the complement, the aggregate divide by 7, if it exceed 7, and the relict ſheweth which of the firſt ſeven Alphabetical letters is the Dominical for that year; if nothing remain, the ſeventh is the Dom. letter; thus in the year 1657 the Sunday letter is D. for if 15 the exceſſe of 14 the *Suns* Circle to 29 be divided by 4, the quotus is 3, which added to 15, is 18, that divided by 7 leaveth 4, which in the order of the letters is D, as before. In Leap-years the letter found is only uſed till the 24 of *February*, from thence forward the next in retrograde order; for Example, in the year 1660. the letter found is A. firſt in uſe, the next backward is B. to be uſed to the years end.

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## Chap. VIII.

### *Of the Golden Number, and the manner of finding it Arithmetically.*

THe Golden Number, vulgarly ſo called, from a cuſtome of the *Athenians*, who uſed to poſt it up in the market place in golden numbers, and after them the *Romans*, againſt the day of the *Moons* change; this Circle was invented by *Meton*, from whence called the Metonical yeare; likewiſe *Decem-novenalis circulus*, becauſe the periodicall revolution of 19 years, in which interval all Lunations, *viz.* New, Full and Quarter *Moons*, were by the Ancients conceived to return to the ſame time and place, wherein they happened 19 years before.

To find how many years are paſſed of this Circle, adde the 1 year paſſed in the year of Chriſts Nativity, to the years ſince, the Sum divided by 19. and the reſidue ſhall declare the Golden number, if nothing remain, then 19 is the G. num. ſo in the year 1657. the Golden number is 5. for if 1658. being the aggregate of the year of our Lord, and one more, be divided by 19, the remainder is 5. which ſheweth ſo many years of 19 to be paſſed ſince the laſt period of the Metonicall year, which alwayes beginneth the firſt day of *January*.

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## CHAP. IX.

### *Of the Epact, and how to find it Arithmetically.*

EPactæ, in the common notion, are a certaine number of dayes by which the Solary exceeds the common Lunary year, which ſo often as they amount to 30. there is one Month to be ſuperadded, whereby every third year is inſtituted Emboliſmal, and is the Lunary Leap-yeare, conſiſting of 13 Months; hence the Lunary year is adæquated to the Solary.

To find this number yearly, multiply the Golden number by 11 (the difference of a Solary and a Lunary year common) the reſult divided by 30. (the dayes of a Lunary Month) ſheweth in the reſidue the number of dayes to be reckoned upon the account of the thirteenth month; for example, in the year 1657. the golden number is 5. which multiplyed by 11 giveth 55, that divided by 30. leaveth 25 for the Epact, which ſheweth that upon the firſt of *March* (for then beginneth the Epact) there are 25 dayes paſſed upon the account of the thirteenth Lunary Month.

*Sheweth*

## CHAP. X.

### *Sheweth to find the day of the Moons change.*

THis propoſition naturally reſulteth from the former; for thence it is manifeſt that the Epact are dayes to be accounted in the age of the thirteenth *Moon*; wherefore, if to the Epact be added the dayes of the enſuing Epact paſſed in the Month wherein you ſeek, (which after this vulgar ſupputation may be one day in a Month) for ſo much well neer the Lunary Month loſeth of the Solary) and the aggregate deducted from 30. if leſſe then 30, but if 30 or more, then from 59. the reſidue ſheweth the day of the change. To inſtance in one Example, admit it were required to know the day of the *Moons* change in the Month of *May Anno* 1657. to this yeare the Epact is 25. to which adde 3, becauſe *May* is the third Month from the beginning of *March* (at what time the Epact beginneth) the Sum is 28. which deducted from 30 leaveth 2. ſhewing the ſecond day of *May* for the *Moons* change: ſee the correction appropriated to this rule in the Epiſtle to the Reader, likewiſe in the fifth Chapter.

## CHAP. XI.

### *To find the day of the week anſwering to any day of the Month aſſigned.*

DIvide the number of dayes from the begining of *January* to the day of the Month required (if they exceed 7) by 7, from the remainder ſubduct the number of the Dom. letter, if you cannot firſt adde 7, and the reſidue is the number of the dayes of the week reckoned after Sunday, if nothing remaine it is ſunday: in Leap-year uſe the firſt Dominical letter only. Hence the 14 of *February* 1657. is found to be Saturday; for if the 45 dayes from the firſt of *January* to the 14 of *February* incluſive be divided by 7, the remainder is 3, which added to 7 (becauſe leſſe then 4, the number of the Dom. letter) the ſum is 10. from which 4 the number of the Dom. letter D. being ſubſtracted the reſidue is 6, the dayes of the week after ſunday, which ſheweth Saturday, as before.

According to this Method is framed a compendious Table which becauſe of its ſingular dexterity to this Propoſition, I have here ſubjoyned, willing thee to have recourſe to the

A Table ſhewing the day of the Week.

| *Dies Menſium.* | | | | | *Janu. Octob.* | *Fe. Mar. No* | *Aprill July* | *May* | *June* | *Auguſt* | *Sept. Dece.* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | 22 | 15 | 8 | 1 | A | D | G | B | E | C | F |
| 30 | 23 | 16 | 9 | 2 | B | E | A | C | F | D | G |
| 31 | 24 | 17 | 10 | 3 | C | F | B | D | G | E | A |
| | 25 | 18 | 11 | 4 | D | G | C | E | A | F | B |
| | 26 | 19 | 12 | 5 | E | A | D | F | B | G | C |
| | 27 | 20 | 13 | 6 | F | B | E | G | C | A | D |
| | 28 | 21 | 14 | 7 | G | C | F | A | D | B | E |

ſixth Chapter, where thou maiſt meet with a full reſolve of its ample uſe.

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## Chap. XII.

### *To find the day when any Moveable Feaſt or Term ſhall happen, and this by Arithmeticall ſupputation.*

ADde 5 to the Epact with the Number of the Dominical letter, the aggregate divide by 7, and the quotus is a number which for diſtinction ſake, I call *Numerus Miſticus*; here note when the Epact is 25. and the Dominical letter *c, d, e, f,* or *g*, or the Epact 28. and the Dom. letter *d, e, f,* or *g*, deduct 4 from *Nu. miſticus* found, and you have it corrected to the next uſe. Again, when the Epact is 28. and the Dom. letter *A*, adde 1 to N. miſticus, and you have it corrected to its proper uſe. Moreover, ſubſtract 1 from N. miſt. and multiply the reſidue by 7, from which product ſubſtract the Dominical letter leſſe by 1, according to the Alphabet order, that relict deduct from 25, but if it exceed, from 60, and there is given the number of direction, which are the dayes to be added to the loweſt falling of any moveable Feaſt or Term, when Nu. miſt. is 1, onely adde the Domin. letter leſſe by 1 to 25. and you have the foreſaid number. In Leap-year review the note appertaining to the fourth Chapter in the like caſe. Leaſt what is taught ſhould ſeem too obſtruſe, admit one example for a generall practice. To finde the day when any moveable Feaſt or Term ſhall happen in the enſuing year, which will be 1657. By the ſeventh and ninth Chapter, the Domin. letter is found to be D. the fourth letter in order, the Epact 25. the Sum of both 29. to which adding 5. the aggregate is 34. this divided by 7, giveth 4 in the quotient for the Num.miſt. Furthermore, deduct 1 from N. miſt. and the remainder is 3, which multiplyed by 7 produceth 21, from this ſubſtracting 3, which is 1 leſſe then the Dom. letter, the relict is 18, and that from 25 leaveth 7, the dayes to be added to the loweſt falling of any moveable Feaſt or Term, happening in the yeare given; wherefore directing your Eye to the following Catalogue of moveable Feaſts and Terms, you have the day of the Month of the loweſt falling of its reſpective Feaſt; to apply this, let it be required to know *Eaſter day*, and likewiſe when that Term beginneth and endeth, and all in the foreſaid year; againſt *Eaſter* ſtandeth the 22 of *March*, to which adding 7, the aggregate is 29, and is the day of that Month upon which *Eaſter day* falleth, again adde 7 to the 8 of *Aprill*, being the loweſt falling of that Terme, the ſum deſigneth the 15 day of *April* for the beginning, but added to the fourth of *May* (the loweſt ending) the eleventh of *May* for the ending; in like manner, if 7 be added to the tenth of *May* the loweſt *Whitſunday*, it is manifeſt that *Whitſunday* in the ſame yeare

ſhall

|  | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| A | 25 | 18 | 11 | 4 | 32 |
| B | 26 | 19 | 12 | 5 | 33 |
| C | 27 | 20 | 13 | 6 | 34 |
| D | 28 | 21 | 14 | 7 | 0 |
| E | 29 | 22 | 15 | 8 | 1 |
| F | 30 | 23 | 16 | 9 | 2 |
| G | 31 | 24 | 17 | 10 | 3 |

ſhall be upon the 17 day of *May*. That the former operation may yet be made more feaſable, I have in this place ſuperadded a moſt compendious Table directing to the number prenoted, and this without further trouble, then to compute N. myſt. which found in the front, and the Dom. letter in the firſt left hand Column, the common angle ſhall aſſign the dayes to be added to the loweſt falling of any moveable Feaſt: in the laſt Example the Dom. letter is D. the N. myſt. 4. with which entring the Table, there is found 7 dayes inſerted in the interſection of both their Columns, being the ſame as before.

*A Catalogue of Feaſts and Terms.*

| Fixed | Day & Mo. |  | Moveable. | Da. mon. |  |
|---|---|---|---|---|---|
| Converſ. St. Paul | 25 | *January* | Shrove-tueſday | 3 | *Feb.* |
| Term begins | 23 |  | Firſt ſund. in Lent | 8 | *Feb.* |
| Purification of Mary. | 2 |  | Eaſter day | 22 | *March* |
| Term ends. | 12 | *February* | Rogation ſunday | 26 | *April* |
| St Matthias the Ap. | 24 |  | Aſcention day | 30 | *April* |
| Annun. of B. Mary. | 25 | *March* | Whitſunday | 10 | *may* |
| St Mark Evangeliſt | 25 | *April* | Trinity ſunday | 17 | *may* |
| Philip and Jacob | 1 | *May* | Eaſter Term begins | 8 | *April* |
| St John Baptiſt | 24 | *June* | And ends. | 4 | *may* |
| St Peter Apoſtle | 29 |  | Trin. Term begins | 22 | *may* |
| St James Apoſtle | 25 | *July* | And ends | 10 | *Iune* |
| Lammas | 1 | *Auguſt* | The reſidue of fixed Feaſts. |  |  |
| St Bartholom. Apoſt | 24 |  | Term endeth | 18 | No- |
| St Matthew Apoſt. | 21 | *Septemb.* | St Andrew Apoſt. | 30 | vemb. |
| St Michael Archang. | 29 |  | St Thomas Apoſt. | 21 |  |
| St Luke Evangeliſt | 18 |  | Chriſts Nativity | 25 |  |
| Term beginneth | 23 | *Octob.* | *Stephen* Protomar. | 26 | *Decem.* |
| Simon and Jude Ap. | 28 |  | St John Evang. | 27 |  |
|  |  |  | Innocents | 28 |  |

Feaſts moveable, varie in the day of the month.
Fixed in the day of the week only.

## CHAP. XIII.

*A Compendious Table ſhewing the houre and minute of the Moons coming to South, applyed to find the time of full Sea or high water in any part of the world, the time of high water at the change or full being once known, the which we have here inſerted againſt ſome particular places, leaving others to be adjoyned according to every mans private uſe.*

| ☽ | ☽ | H. | M. |
|---|---|---|---|
| 1 | 16 | 00 | 48 |
| 2 | 17 | 01 | 36 |
| 3 | 18 | 02 | 24 |
| 4 | 19 | 03 | 12 |
| 5 | 20 | 04 | 00 |
| 6 | 21 | 04 | 48 |
| 7 | 22 | 05 | 36 |
| 8 | 23 | 06 | 24 |
| 9 | 24 | 07 | 12 |
| 10 | 25 | 08 | 00 |
| 11 | 26 | 08 | 48 |
| 12 | 27 | 09 | 36 |
| 13 | 28 | 10 | 24 |
| 14 | 29 | 11 | 12 |
| 15 | 30 | 12 | 00 |

BY the fifth Chapter of the ocular Almanacke collect the Age of the *Moon*, with which enter the prenoted Table, and directly againſt it ſtandeth the hours and minutes required.

To inſtance in one *Example*, and then apply it to our preſent purpoſe; ſuppoſe that upon a certain day of the Month the *Moon* be 10 or 25 dayes old, with which entring the firſt or ſecond Column of the Table, againſt either age ſtandeth 8 ho. which ſheweth, that the *Moon* being 10 or 25 dayes old, cometh to the Meridian at 8 of the clock, according to vulgar account. Now if you deſire the time of high water at *London*, or *Amſterdam* to the preceding age of the *Moon*, adde the 3 hours inſerted againſt *London* &c. to 8 ho. and the ſum, *viz.* 11 hours is the time of full Sea in both places; the like is to be underſtood of all other places, onely remember, that if the ſum exceed 12 hours, you firſt ſubſtract 12 ho. and the reſidue is the time of high-water.

## *A Catalogue of divers places, with the time of high water in every of those places, at the change or full of the Moon.*

| | | |
|---|---|---|
| Queenburrough, Iſle of Wight | 12 | 00 |
| Rocheſter Aberden | 12 | 45 |
| Graveſend, Downs | 1 | 30 |
| Silly, Lysbone | 2 | 15 |
| London, Amſterdam | 3 | 00 |
| Flamborough, Fluſhing | 3 | 45 |
| ork-haven, Dunbar | 4 | 30 |
| ew-caſtle, Falmouth. | 5 | 15 |
| limmouth, Antwerp | 6 | 00 |
| riſtoll at the ſtart | 6 | 45 |
| ilford, Lands-end | 7 | 30 |
| ortland, the Hahue, Dublin | 8 | 15 |
| ool, St Hellen | 9 | 00 |
| eedles, Deep | 9 | 45 |
| mouth, Calice road | 10 | 30 |
| , Gorend, Rhodes | 11 | 15 |

An Appendix to the preceding Almanack, whereby it is extended to a more generall uſe; ſhewing as well by Tables as Trigonometry, the Suns place, his Declination, his Riſing and Setting with his Right and Oblique Aſcentions, and difference Aſcentionall, the Riſing and Southing of the Stars, together with the invention of the longitude and latitude of places, ſome the moſt eminent of which compriſed in a Table with other previous adjuncts.

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## CHAP. I.

### *Of a Circle and his gradual diviſion.*

A Circle is defined to be a plaine and round figure, equally diſtant from his centre; in this are reckoned all dimenſions pertaining to the Cœleſtial motion, and intervals upon this our terreſtrial Superficies: to which purpoſe as well *Geographers* as *Aſtronomers* have with common conſent divided it into 360 Parts or Sections, this being a number moſt apt and convenient for the uſuall ſubdiviſions, in which every learner muſt neceſſarily be well acquainted with ere he enter upon the firſt principles of the Mathematicks. Hence a degree is one part of 360, a ſign 30 deg. and is the twelfth part of the Circle; In reference to the Mariners Compaſſe, the Circle is alſo divided into 32 parts, being ſo many points, winds or Rumbs every of which containeth 11 gr. 15 min. A minute the 60 part of a degree, a ſecond the 60 part of a minute, &c. Again, in reſpect of time, the whole circle or 360 gr. is 24 hours, and by conſequence 15 gr. one hour, one degree 4 minutes of time, and 15 min. of a degree 1 min. of time.

Finally, if we reſpect the Globe of the Earth, 1 degree in a circle concentrick with the Earth, or that divides it into two equal Hemiſphæres, doth equalize 60 *Italian* miles, therefore the whole circumference 60 times 360 miles. This premiſed, I proceed to addition and ſubſtraction of the foreſaid parts: as for multiplication and diviſion that which is ordinary ſuffiſeth to our uſe, and further I ſhall not wittingly trouble my Reader, or thereby augment the bulk of my book.

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## CHAP. II.

### *To adde Aſtronomical Fractions.*

AS in vulgar addition of whole Numbers and Fractions, whether in money, weight, or meaſure, you diſtinguiſh the whole and his parts with ſome Character, thereby to note their reſpective ſpecies or kinds, ſo here, over Signs place an *S.* over Degrees a *D.* over Minutes a ſingle daſh, thus *l.* over ſeconds two daſhes, thus *ll.*&c. Proceed then to ſet Signs under Signs, degrees under degrees, and like kinds under like. In like manner if you are to adde the parts of time, place dayes under dayes, hours under hours, and minutes under minutes, &c. then beginning with the right hand numbers, firſt adde thoſe of the leaſt ſpecies by collecting all the unites into one ſum, which if they amount to tenths, ſet down the unites under unites of the like kind, but the tenths carry to the place of tenths, which added with the number carried (accounting every tenth as a unite) ſee how often 6 may be found in that ſum, which number (accounting every 6 as a unite) carry to the next ſpecies, placing what is leſſe then 6 in the proper place; thus do until you come to degrees, which when you have added their place of tenths, conſider how often 30, if you reckon them tens, or 3, if unites, may be found in that ſum, the which whatever the quotient be, carry to Signs, the reſidue place under degrees, and having added the ſigns, reject all the twelfths, and ſet down the reſidue under Signs, all which may be better perceived by one example, then to multiply many words, admit I would adde the following numbers,

| *S.* | *D.* | *l.* | *ll.* |
|---|---|---|---|
| 5 | 17 | 32 | 17 |
| 10 | 25 | 45 | 26 |
| 1 | 10 | 21 | 04 |
| 5 | 23 | 38 | 47 |

Firſt I adde the unites of the ſeconds, for they are of the leaſt ſpecies, the ſum is 17. I ſet down 7, and adde the 1 to the tenths of the ſame ſeconds the ſum is 5 which I place under the tenths: ſecondly, I adde the unites of the minutes, which in all make 8, theſe I ſet in their due place, and ſince there is nothing carried I adde onely the tenths of the minutes, their ſum is 9, out of which I take 6. once, and the reſidue 3 I ſet in its order.

Thirdly, I adde the unites of the degrees, which with the 1 carried (being once 6) the totall is 13. I ſet 3 under the place of unites, and adde the one tenth to the tenths of degrees, which gathered together make 5, in this, 3 may be found once, the remainder 2 I ſet in his due place, but the 1 carried I adde to the unites of ſignes, all which with their tenths make 17, from this, 12 being deducted the reſidue is 5, which joyned with the former, maketh the aggregate of this addition 5 ſig. 23 degr. 38 min. 57 ſeconds.

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## CHAP. III.

### *To ſubſtract Aſtronomical Fractions.*

Like as in addition you placed like kinds under like, with their peculiar notes, and as in vulgar ſubſtraction, when the inferior number cannot conveniently be ſubſtracted from the ſuperior, you borrow a unite of the next ſpecies, which thing muſt here be obſerved alſo, accounting every ſuch for 60, nevertheleſſe calling it but 1, adde it to the next to be ſubſtracted, the ſum ſubſtract as before; but when you come to degrees, account the unite borrowed onely 30, which muſt alſ be repaid with a unite, by adding 1 to the ſignes in the next place; all which will be made more familiar by one Example, in which I would ſubſtract 2 ſig. 22 deg. 17 min. 25 ſec. from 7 ſi. 10. d. 42 min. 6 ſec.

| S | D. | l. | ll. |
|---|---|---|---|
| 7 | 10 | 42 | 06 |
| 2 | 22 | 17 | 25 |
| 4 | 18 | 24 | 41 |

Beginning with the ſeconds, I ſay 5 out of 6 reſteth 1, then 2 in the place of tens out of 0, I cannot, wherefore borrowing 60 or 6 tenths, it is made 6, from which 2 being taken, the reſidue is 4. Again in the next Collumn repaying 1 to 7, it maketh 8, which to take from 2 I cannot, therefore borrowing a unite from the place of tenths it is made 12, out of which 8 being deducted, the remaineer is 4; then in the place of tenth 1 and the 1 borrowed, their ſum is 2, this ſubſtracted from 4, the relict is 2: in the next Column I ſay alſo, 2 out of 0 I cannot, but out of 10, reſt 8, then 1 that was borrowed, and 2 in the place of tenths is 3 which taken from 1 cannot be, but borrowing 30 or 3 tenths, it is made 4, from which if 3 be taken, the remainder is 1; in the laſt Column 1 that was borrowed and 2 is 3, this from 7, the reſidue is 4, ſo then the whole remainder is 4 ſig. 18 deg. 24 min. 41 ſec.

## CHAP. IV.

### *To find the Proportionall part.*

THe proportionall part is a fourth number to be found in proportion to three numbers given, and muſt therefore be effected by the golden rule, by ſaying, as the firſt to the ſecond, ſo the third to the fourth, which ſhall be the proportional number required; to inſtance in this example, admit the *Suns* place be in 20 d. 45 m. of ♈, to which let it be required to find the Declination, wherefore entring the Table peculiar to this purpoſe with the ſign in the front and the degree in the left hand Column againſt 20 deg. in the ſquare angle is found 7 d. 51 min. Now becauſe there remaineth 45 min. and that to 1 degree more there anſwereth 8 deg. 13 min. ſay if 1 degree or 60 m. require 22 m. the difference of 1 degree, what doth 45, which by the uſual working ſheweth 16 m. 30 ſec. for the part proportional, as appeareth by the operation here ſubſcribed in figures.

♈ 21 d. The decli. 8 d. 13 m. as 60 m. to 22.
20 7 51. ſo 45 to 16 30 *ll*.
Diff. of one degree 22

45*l* 60|990 (16*l* 30*ll*
22*l* 60
90 390
90 360
990 30

## CHAP. V.

### *To calculate the true place of the Sun, according to Harmonicon Cœleſte.*

FIrſt by the Table entituled [a Table of the equall motion of the *Sun* for 300 years] collect into one ſum the mean motions anſwering to the year, month, day &c. given: but if the year be compleat, as are all thoſe beginning at 1650. and increaſing by 20 to 1950. adde the numbers againſt that yeare to the numbers belonging to 0. inſerted at the head of the intermediate years.

Secondly, with the Anomalie agreeing to the given time, enter the Table entituled [a Table of the Æquation of the *Sun*] finding the ſigne in the head of the Table, and the degree in the firſt left left hand Column, which if you cannot, then in the foot of the Table, and the degree in the firſt Column on the right hand, and the common angle (after proportion is made for the odde minutes) ſhall aſſign the difference between the true and equal motion, which difference, adde, or ſubſtract to or from the equall motion, according as the title where you find the ſign ſhall direct, and you have the true place of the *Sun* in ſigns, degrees and minutes. To illuſtrate this, take two examples; in the firſt, admit the *Suns* place were required to the firſt of *May, Anno* 1657. the *Sun* being then upon the Meridian; in the prenoted Table

find

finde the motions to the next compleat yeare leſſe then that given, *viz.* 1650. and tranſcribe them in the following order, to which ſubjoyn the motions agreeing to the 7 years remaining, then the motions belonging to *May* in the common year; laſtly ſubſcribe the motions to 1 day yet remaining, and adding them of like ſpecies, their ſeverall aggregates manifeſt the motions to the time propoſed.

| Years. | *S.* | *D.* | *M.* | *S.* | *D.* | *M.* |
|---|---|---|---|---|---|---|
| 1650 | 00 | 00 | 00 | 00 | 00 | 00 |
| 7 | 09 | 20 | 24 | 06 | 13 | 49 |
| *May* | 03 | 28 | 17 | 03 | 28 | 17 |
| Dayes 1 | | | 59 | | | 59 |
| The *S.* mean mo. | 01 | 19 | 40 | 10 | 13 | 5 Anomalie |
| Æquation adde | | 1 | 28 | The ☉ in 21 deg. 8 min. ♉. | | |
| The *S.* true place | 01 | 21 | 08 | | | |

Again, let it be propoſed to find the *Suns* place to the 6 day of *Aug.* 1670. at three hours after noon.

| | *S.* | *D.* | *M* | *S.* | *D.* | *M.* |
|---|---|---|---|---|---|---|
| 1670 | 00 | 00 | 09 | 11 | 29 | 48 |
| 0 | 09 | 20 | 06 | 6 | 13 | 32 |
| *Auguſt* | 06 | 28 | 57 | 6 | 28 | 57 |
| Dayes 6 | | 5 | 55 | | 5 | 55 |
| Hours 3 | | | 7 | | | 7 |
| Equall motion | 04 | 25 | 14 | 1 | 18 | 19 Anomalie. |
| Æquation ſub. | | 1 | 30 | The *Suns* place 23 de. 44 min. ♌. | | |
| True motion | 04 | 23 | 44 | | | |

Here note, that the Table of the *Suns* mean motion is accommodated onely to thoſe places ſcituate under one and the ſame Meridian with *London*, which is accounted *Eaſtward* from the firſt Meridian 21 deg. 0 min. wherefore if the *Suns* place be required to any other Meridian, adde the difference of Longitude (converted into time by the firſt Chapter) if Eaſtward from *London*, but ſubſtract, if weſtward, to or from the time given, and you have it æquated to the former uſe: but to ſave thee a labour, (ſeemingly ſo, if not the more expert in things of this nature) I have added end in the of this *Appendix*, a Catalogue of ſome of the moſt eminent places in the World, with their difference of Longitude from *London*, inſerted in the laſt Column, to be added or ſubſtracted from the given time, as is ſignified by their ſeverall notes of *A.* or *S.*

Having the number of the Sign that the *Sun* poſſeſſeth, enter with it among the following numbers, and you have the correſpondent Signe, with his Character.

| | | | | | |
|---|---|---|---|---|---|
| 1<br>*Aries*<br>♈ | 2<br>*Taurus*<br>♉ | 3<br>*Gemini*<br>♊ | 4<br>*Cancer*<br>♋ | 5<br>*Leo*<br>♌ | 6<br>*Virgo*<br>♍ |
| 7<br>*Libra*<br>♎ | 8<br>*Scorpio*<br>♏ | 9<br>*Sagitta.*<br>♐ | 10<br>*Caprico.*<br>♑ | 11<br>*Aquar.*<br>♒ | 12<br>*Piſces*<br>♓ |

CHAP.

## CHAP. VI.

### *To find the Declination of the Sun at any time or place aſſigned.*

IN the Table entituled [ A Table of the *Suns* Declination ] enter with the *Suns* place found as above, the ſign in the front, and the degree in the firſt Column on the left hand, whileſt he tranſits ♈, ♉, ♊, ♎, ♏, ♐, but if other ſigns, then in the bottome of the Table, and the degree in the firſt right hand Column, and the common angle ſhall indigit the Declination, which is either North or South, as the letter *N.* or *S.* over or under the ſign given doth direct; if minutes belong to the degree of the *Suns* place, find their proportionall part by the fourth Chapter, which if the Declination increaſe, muſt be added, but decreaſing ſubſtracted to or from the Declination belonging to the degree of the *Suns* place, the like muſt be obſerved in other Tables; for example, ſuppoſe the *Sun* poſſeſſeth 23 d. 44 m. of ♌. and it be required to find the Declination of that point of the Ecliptick.

| | | |
|---|---|---|
| Sign ♌ 23 de. declin. 13 d. 54 m. | | Difference of declination to 1 de. more is 20 min. |
| Note N. Subſtract | 15 | |
| 13 | 39 | |

therefore the part proportional 14l. 40ll. to be ſub. Hence the Declination of the *Sun* 13 deg. 39 min. North from the Æquinoctial.

# A Table of the Equal motion of the Sun for 300 Yeares.

| Year of Chri. | Equal motion ☉. |  |  | Equ. Anomalie ☉ |  |  |
|---|---|---|---|---|---|---|
|  | S. | D. | m. | S. | D. | m. |
| 1650 | 0 | 00 | 00 | 00 | 00 | 00 |
| 70 | 0 | 00 | 09 | 11 | 29 | 48 |
| 1690 | 0 | 00 | 18 | 11 | 29 | 37 |
| 10 | 0 | 00 | 27 | 11 | 29 | 25 |
| 1730 | 0 | 00 | 36 | 11 | 29 | 14 |
| 50 | 0 | 00 | 45 | 11 | 29 | 02 |
| 1770 | 0 | 00 | 54 | 11 | 28 | 51 |
| 90 | 0 | 01 | 03 | 11 | 28 | 39 |
| 1810 | 0 | 01 | 12 | 11 | 28 | 27 |
| 30 | 0 | 01 | 21 | 11 | 28 | 16 |
| 1850 | 0 | 01 | 30 | 11 | 28 | 04 |
| 70 | 0 | 01 | 39 | 11 | 27 | 53 |
| 1890 | 0 | 01 | 48 | 11 | 27 | 41 |
| 10 | 0 | 01 | 57 | 11 | 27 | 30 |
| 1930 | 0 | 02 | 06 | 11 | 27 | 18 |
| 50 | 0 | 02 | 15 | 11 | 27 | 06 |
| 0 | 9 | 20 | 06 | 6 | 13 | 32 |
| 1 | 9 | 19 | 51 | 6 | 13 | 17 |
| B 2 | 9 | 19 | 37 | 6 | 12 | 51 |
| 3 | 9 | 20 | 22 | 6 | 13 | 45 |
| 4 | 9 | 20 | 08 | 6 | 13 | 30 |
| 5 | 9 | 19 | 53 | 6 | 13 | 14 |
| B 6 | 9 | 19 | 39 | 6 | 12 | 59 |
| 7 | 9 | 20 | 24 | 6 | 13 | 49 |
| 8 | 9 | 20 | 09 | 6 | 13 | 17 |
| 9 | 9 | 19 | 55 | 6 | 13 | 12 |
| B 10 | 9 | 19 | 41 | 6 | 12 | 57 |
| 11 | 9 | 20 | 25 | 6 | 13 | 40 |
| 11 | 9 | 20 | 11 | 6 | 13 | 25 |
| 12 | 9 | 19 | 57 | 6 | 13 | 10 |
| B 14 | 9 | 19 | 42 | 6 | 12 | 54 |
| 15 | 9 | 20 | 27 | 6 | 13 | 38 |
| 16 | 9 | 20 | 13 | 6 | 13 | 23 |
| 17 | 9 | 19 | 59 | 6 | 13 | 07 |
| B 18 | 9 | 19 | 44 | 6 | 12 | 52 |
| 19 | 9 | 20 | 29 | 6 | 13 | 36 |

| Dayes or Hours | The motion of the ☉ and anomalie to dayes. |  | ☉ motions to hours. |
|---|---|---|---|
|  | D. | M. | mi |
| 1 | 00 | 59 | 2 |
| 2 | 01 | 58 | 5 |
| 3 | 02 | 57 | 7 |
| 4 | 03 | 56 | 10 |
| 5 | 04 | 56 | 12 |
| 6 | 05 | 55 | 15 |
| 7 | 06 | 54 | 17 |
| 8 | 07 | 53 | 20 |
| 9 | 08 | 52 | 22 |
| 10 | 09 | 51 | 24 |
| 11 | 10 | 50 | 27 |
| 12 | 11 | 50 | 29 |
| 13 | 12 | 49 | 32 |
| 14 | 13 | 48 | 34 |
| 15 | 14 | 47 | 37 |
| 16 | 15 | 46 | 39 |
| 17 | 16 | 45 | 42 |
| 18 | 17 | 44 | 44 |
| 19 | 18 | 44 | 47 |
| 20 | 19 | 43 | 49 |
| 21 | 20 | 42 | 52 |
| 22 | 21 | 41 | 54 |
| 23 | 22 | 40 | 57 |
| 24 | 23 | 39 | 59 |
| 25 | 24 | 38 |  |
| 26 | 25 | 37 |  |
| 27 | 26 | 37 |  |
| 28 | 27 | 36 |  |
| 29 | 28 | 35 |  |
| 30 | 29 | 34 |  |
| 31 | 30 | 33 |  |

### The Equal motion of ☉ and Ano. in months of the common year.

|  | S. | D. | M. |
|---|---|---|---|
| *January* | 00 | 00 | 00 |
| *February* | 01 | 00 | 33 |
| *March* | 01 | 28 | 9 |
| *April* | 02 | 28 | 42 |
| *May* | 03 | 28 | 17 |
| *June* | 04 | 28 | 50 |
| *July* | 05 | 28 | 24 |
| *August* | 06 | 28 | 57 |
| *September* | 07 | 29 | 31 |
| *October* | 08 | 29 | 5 |
| *November* | 09 | 29 | 38 |
| *December* | 10 | 29 | 1 |

### The former motions for the Biſ. year.

|  | S. | D. | m. |
|---|---|---|---|
| *January* | 00 | 00 | 00 |
| *February* | 01 | 00 | 33 |
| *March* | 01 | 29 | 8 |
| *Aprill* | 01 | 29 | 41 |
| *May* | 03 | 29 | 16 |
| *June* | 04 | 29 | 49 |
| *July* | 05 | 29 | 22 |
| *August* | 06 | 29 | 56 |
| *September* | 08 | 00 | 3 |
| *October* | 09 | 00 | 4 |
| *November* | 10 | 00 | 37 |
| *December* | 11 | 00 | 1 |

## A Table of the Æquation of the Sun or difference of the true and equal motion.

| Anom ⊙ | S. 0 Sub. d. | m | S 1 ſub. d | m | S 2 ſub. d | m | S 3 ſub. d | m | S 4 ſub. d | m | S 5 ſub. d | m | Anom ⊙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 |  | 0 | 1 | 0 | 1 | 45 | 2 | 3 | 1 | 48 | 1 | 3 | 30 |
| 1 |  | 2 |  | 2 |  | 46 |  | 3 |  | 47 | 1 | 1 | 29 |
| 2 |  | 4 |  | 4 |  | 47 |  | 3 |  | 46 | 0 | 59 | 28 |
| 3 |  | 6 |  | 6 |  | 48 |  | 3 |  | 44 |  | 57 | 27 |
| 4 |  | 8 |  | 7 |  | 49 |  | 3 |  | 43 |  | 55 | 26 |
| 5 |  | 10 |  | 9 |  | 50 |  | 3 |  | 42 |  | 53 | 25 |
| 6 |  | 12 |  | 11 |  | 51 |  | 2 |  | 41 |  | 51 | 24 |
| 7 |  | 15 |  | 13 |  | 52 |  | 2 |  | 40 |  | 49 | 23 |
| 8 |  | 17 |  | 14 |  | 53 |  | 2 |  | 38 |  | 47 | 22 |
| 9 |  | 19 |  | 16 |  | 54 |  | 2 |  | 37 |  | 45 | 21 |
| 10 |  | 21 |  | 18 |  | 54 |  | 1 |  | 36 |  | 43 | 20 |
| 11 |  | 23 |  | 19 |  | 55 |  | 1 |  | 34 |  | 41 | 19 |
| 12 |  | 25 |  | 21 |  | 56 |  | 1 |  | 33 |  | 39 | 18 |
| 13 |  | 27 |  | 22 |  | 57 |  | 0 |  | 31 |  | 37 | 17 |
| 14 |  | 29 |  | 24 |  | 57 | 2 | 0 |  | 30 |  | 35 | 16 |
| 15 |  | 31 |  | 25 |  | 58 | 1 | 59 |  | 28 |  | 32 | 15 |
| 16 |  | 33 |  | 27 |  | 58 |  | 59 |  | 27 |  | 30 | 14 |
| 17 |  | 35 |  | 28 |  | 59 |  | 58 |  | 25 |  | 28 | 13 |
| 18 |  | 37 |  | 30 |  | 59 |  | 58 |  | 24 |  | 26 | 12 |
| 19 |  | 39 |  | 31 | 2 | 0 |  | 57 |  | 22 |  | 24 | 11 |
| 20 |  | 41 |  | 33 |  | 0 |  | 56 |  | 20 |  | 22 | 10 |
| 21 |  | 43 |  | 34 |  | 1 |  | 56 |  | 19 |  | 20 | 9 |
| 22 |  | 45 |  | 35 |  | 1 |  | 55 |  | 17 |  | 17 | 8 |
| 23 |  | 47 |  | 37 |  | 2 |  | 54 |  | 15 |  | 15 | 7 |
| 24 |  | 49 |  | 38 |  | 2 |  | 53 |  | 14 |  | 13 | 6 |
| 25 |  | 51 |  | 39 |  | 2 |  | 53 |  | 12 |  | 11 | 5 |
| 26 |  | 53 |  | 40 |  | 2 |  | 52 |  | 10 |  | 9 | 4 |
| 27 |  | 55 |  | 42 |  | 2 |  | 51 |  | 8 |  | 7 | 3 |
| 28 |  | 57 |  | 43 |  | 3 |  | 50 |  | 6 |  | 4 | 2 |
| 29 |  | 58 |  | 44 |  | 3 |  | 49 |  | 4 |  | 2 | 1 |
| 30 | 1 | 0 | 1 | 45 | 2 | 3 | 1 | 48 | 1 | 3 | 0 | 0 | 0 |
| Deg. | Ad. S 11 |  | Ad. S 10 |  | Ad. S 9 |  | Ad. S 8 |  | Ad. S 7 |  | Ad. S 6 |  | Deg. |

## A Table of the Suns declination for every deg. of the Ecliptick

| Degrees | N ♈ d | S ♎ m | N ♉ d | S ♏ m | N ♊ d | S ♐ m | Degrees |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 24 | 11 | 52 | 20 | 26 | 29 |
| 2 |  | 48 | 12 | 13 |  | 38 | 28 |
| 3 | 1 | 12 |  | 33 |  | 50 | 27 |
| 4 |  | 36 |  | 54 | 21 | 1 | 26 |
| 5 | 2 | 0 | 13 | 14 |  | 12 | 25 |
| 6 |  | 23 |  | 34 |  | 23 | 24 |
| 7 |  | 47 |  | 54 |  | 33 | 23 |
| 8 | 3 | 11 | 14 | 14 |  | 44 | 22 |
| 9 |  | 35 |  | 33 |  | 53 | 21 |
| 10 |  | 58 |  | 51 | 22 | 2 | 20 |
| 11 | 4 | 22 | 15 | 11 |  | 10 | 19 |
| 12 |  | 46 |  | 29 |  | 19 | 18 |
| 13 | 5 | 9 |  | 48 |  | 26 | 17 |
| 14 |  | 32 | 16 | 6 |  | 34 | 16 |
| 15 |  | 56 |  | 24 |  | 41 | 15 |
| 16 | 6 | 19 |  | 41 |  | 47 | 14 |
| 17 |  | 42 |  | 58 |  | 53 | 13 |
| 18 | 7 | 5 | 17 | 15 |  | 59 | 12 |
| 19 |  | 28 |  | 32 | 23 | 4 | 11 |
| 20 |  | 51 |  | 48 |  | 9 | 10 |
| 21 | 8 | 13 | 18 | 4 |  | 13 | 9 |
| 22 |  | 36 |  | 20 |  | 17 | 8 |
| 23 |  | 58 |  | 35 |  | 20 | 7 |
| 24 | 9 | 21 |  | 50 |  | 23 | 6 |
| 25 |  | 43 | 19 | 5 |  | 26 | 5 |
| 26 | 0 | 5 |  | 19 |  | 28 | 4 |
| 27 |  | 26 |  | 33 |  | 29 | 3 |
| 28 |  | 48 |  | 47 |  | 30 | 2 |
| 29 | 11 | 9 | 20 | 0 |  | 31 | 1 |
| 30 |  | 31 |  | 13 |  | 31 | 0 |
| Deg. | ♍ N | ♓ S | ♌ N | ♒ S | ♋ N | ♑ S | Deg. |

# *A Table of Aſcentional differences.*

| Lat. | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 25 | 26 | 27 | 28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Deg. | m. | m. | m. | m. | m. | m. | m. | m. | m. | m. | m. | m. | m. | m. | m. | m. |
| 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| 2 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 4 | 4 | 4 | 4 | 4 |
| 3 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 4 | 5 | 5 | 6 | 6 | 6 | 6 |
| 4 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 5 | 5 | 6 | 6 | 7 | 7 | 8 | 8 | 9 |
| 5 | 1 | 1 | 2 | 3 | 4 | 4 | 5 | 6 | 7 | 7 | 8 | 9 | 9 | 10 | 10 | 11 |
| 6 | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 11 | 12 | 12 | 13 |
| 7 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 13 | 13 | 14 | 14 | 15 |
| 8 | 1 | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 13 | 14 | 15 | 16 | 16 | 17 |
| 9 | 1 | 3 | 4 | 5 | 6 | 8 | 9 | 10 | 12 | 13 | 15 | 16 | 17 | 18 | 19 | 19 |
| 10 | 1 | 3 | 4 | 6 | 7 | 9 | 10 | 12 | 13 | 15 | 16 | 18 | 19 | 20 | 21 | 22 |
| 11 | 2 | 3 | 5 | 6 | 8 | 9 | 11 | 13 | 14 | 16 | 18 | 20 | 21 | 22 | 23 | 24 |
| 12 | 2 | 3 | 5 | 7 | 9 | 10 | 12 | 4 | 16 | 18 | 20 | 22 | 23 | 24 | 25 | 26 |
| 13 | 2 | 4 | 6 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 24 | 25 | 26 | 27 | 28 |
| 14 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 19 | 21 | 23 | 25 | 27 | 28 | 29 | 30 |
| 15 | 2 | 4 | 6 | 9 | 11 | 13 | 15 | 18 | 20 | 22 | 25 | 27 | 29 | 30 | 31 | 33 |
| 16 | 2 | 5 | 7 | 9 | 12 | 14 | 16 | 19 | 21 | 24 | 27 | 29 | 31 | 32 | 34 | 35 |
| 17 | 2 | 5 | 7 | 10 | 12 | 15 | 17 | 20 | 23 | 26 | 28 | 31 | 33 | 34 | 36 | 37 |
| 18 | 3 | 5 | 8 | 10 | 13 | 16 | 19 | 21 | 24 | 27 | 30 | 33 | 35 | 36 | 38 | 40 |
| 19 | 3 | 6 | 8 | 11 | 14 | 17 | 20 | 23 | 26 | 29 | 32 | 35 | 37 | 39 | 40 | 42 |
| 20 | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 34 | 37 | 39 | 41 | 43 | 45 |
| 21 | 3 | 6 | 9 | 12 | 16 | 19 | 22 | 25 | 29 | 32 | 36 | 39 | 41 | 43 | 45 | 47 |
| 22 | 3 | 6 | 10 | 13 | 16 | 20 | 23 | 26 | 30 | 34 | 38 | 11 | 43 | 45 | 48 | 50 |
| 23 | 3 | 7 | 10 | 14 | 17 | 21 | 24 | 28 | 32 | 36 | 40 | 44 | 46 | 48 | 50 | 52 |
| 24 | 4 | 7 | 11 | 14 | 18 | 22 | 25 | 29 | 33 | 37 | 42 | 46 | 48 | 50 | 52 | 55 |

## The reſidue of Aſcentional differences.

| Lat. | 29 | 30 | 31 | | 32 | | 33 | | 34 | | 35 | | 36 | | 37 | | 38 | | 39 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Deg. | m. | m. | h | m. | h | m | h | m. | h | m. | h | m. | h | m. | h | m. | h | m | h | m. |
| 1 | 2 | 2 | | 2 | | 2 | | 3 | | 3 | | 3 | | 3 | | 3 | | 3 | | 3 |
| 2 | 4 | 5 | | 5 | | 5 | | 5 | | 5 | | 6 | | 6 | | 6 | | 6 | | 6 |
| 3 | 7 | 7 | | 7 | | 8 | | 8 | | 8 | | 8 | | 9 | | 9 | | 9 | | 10 |
| 4 | 9 | 9 | | 10 | | 10 | | 10 | | 11 | | 11 | | 12 | | 12 | | 13 | | 13 |
| 5 | 11 | 12 | | 12 | | 13 | | 13 | | 14 | | 14 | | 15 | | 15 | | 16 | | 16 |
| 6 | 13 | 14 | | 14 | | 15 | | 16 | | 16 | | 17 | | 18 | | 18 | | 19 | | 20 |
| 7 | 16 | 16 | | 17 | | 18 | | 18 | | 19 | | 20 | | 10 | | 21 | | 22 | | 23 |
| 8 | 18 | 19 | | 19 | | 20 | | 21 | | 22 | | 23 | | 22 | | 24 | | 25 | | 26 |
| 9 | 20 | 21 | | 22 | | 23 | | 24 | | 25 | | 25 | | 26 | | 27 | | 28 | | 29 |
| 10 | 22 | 23 | | 24 | | 25 | | 26 | | 27 | | 28 | | 29 | | 31 | | 32 | | 33 |
| 11 | 25 | 26 | | 27 | | 28 | | 29 | | 30 | | 31 | | 32 | | 34 | | 35 | | 36 |
| 12 | 27 | 28 | | 29 | | 31 | | 32 | | 33 | | 34 | | 36 | | 37 | | 38 | | 40 |
| 13 | 29 | 31 | | 32 | | 33 | | 35 | | 36 | | 37 | | 39 | | 40 | | 42 | | 43 |
| 14 | 32 | 33 | | 34 | | 36 | | 37 | | 39 | | 40 | | 42 | | 43 | | 45 | | 47 |
| 15 | 34 | 36 | | 37 | | 39 | | 40 | | 42 | | 43 | | 45 | | 47 | | 48 | | 50 |
| 16 | 37 | 38 | | 40 | | 41 | | 43 | | 45 | | 46 | | 48 | | 50 | | 52 | | 54 |
| 17 | 39 | 41 | | 42 | | 44 | | 46 | | 48 | | 49 | | 51 | | 53 | | 55 | | 57 |
| 18 | 42 | 43 | | 45 | | 47 | | 49 | | 51 | | 52 | | 55 | | 57 | | 59 | 1 | 1 |
| 19 | 44 | 46 | | 48 | | 50 | | 52 | | 54 | | 56 | | 58 | 1 | 0 | 1 | 2 | | 5 |
| 20 | 47 | 49 | | 51 | | 53 | | 55 | | 57 | | 59 | 1 | 1 | | 4 | | 6 | | 9 |
| 21 | 49 | 51 | | 53 | | 56 | | 58 | 1 | 0 | 1 | 2 | | 5 | | 7 | | 10 | | 12 |
| 22 | 52 | 54 | | 56 | | 58 | 1 | 1 | | 3 | | 6 | | 8 | | 11 | | 14 | | 16 |
| 23 | 54 | 57 | | 59 | 1 | 2 | | 4 | | 7 | | 9 | | 12 | | 15 | | 17 | | 20 |
| 24 | 57 | 60 | 1 | 2 | | 5 | | 7 | | 10 | | 13 | | 15 | | 18 | | 21 | | 25 |

# The reſidue of Aſcentional differences.

| Lat. | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dg. | h m. | h m. | h m. | h m. | h m. | h m. | h m. | h m. | h m. | h m. | h m. |
| 1 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 |
| 2 | 7 | 7 | 7 | 7 | 8 | 8 | 8 | 9 | 9 | 9 | 10 |
| 3 | 10 | 10 | 11 | 11 | 12 | 12 | 12 | 13 | 13 | 14 | 14 |
| 4 | 13 | 14 | 14 | 15 | 15 | 16 | 17 | 17 | 18 | 18 | 19 |
| 5 | 17 | 17 | 18 | 19 | 19 | 20 | 21 | 22 | 22 | 23 | 24 |
| 6 | 20 | 21 | 22 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 7 | 24 | 25 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 34 |
| 8 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 35 | 36 | 37 | 39 |
| 9 | 31 | 32 | 33 | 34 | 35 | 36 | 38 | 39 | 41 | 42 | 44 |
| 10 | 34 | 35 | 37 | 38 | 39 | 41 | 42 | 44 | 45 | 47 | 49 |
| 11 | 38 | 39 | 40 | 42 | 43 | 45 | 46 | 48 | 50 | 52 | 54 |
| 12 | 41 | 43 | 44 | 46 | 47 | 49 | 51 | 53 | 55 | 57 | 59 |
| 13 | 45 | 46 | 48 | 50 | 52 | 53 | 55 | 57 | 59 | 1 2 | 1 4 |
| 14 | 48 | 50 | 52 | 54 | 56 | 58 | 1 0 | 1 2 | 1 4 | 7 | 9 |
| 15 | 52 | 54 | 56 | 58 | 1 0 | 1 2 | 4 | 7 | 9 | 12 | 14 |
| 16 | 56 | 58 | 1 0 | 1 2 | 4 | 7 | 9 | 12 | 14 | 17 | 20 |
| 17 | 59 | 1 2 | 4 | 6 | 9 | 11 | 14 | 17 | 16 | 22 | 25 |
| 18 | 1 3 | 6 | 8 | 11 | 13 | 16 | 19 | 22 | 25 | 28 | 31 |
| 19 | 7 | 10 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 37 |
| 20 | 11 | 14 | 17 | 19 | 22 | 25 | 29 | 32 | 35 | 39 | 43 |
| 21 | 15 | 18 | 21 | 24 | 27 | 30 | 34 | 37 | 41 | 45 | 49 |
| 22 | 19 | 22 | 25 | 29 | 32 | 35 | 39 | 43 | 47 | 51 | 55 |
| 23 | 23 | 27 | 30 | 33 | 36 | 40 | 44 | 48 | 53 | 57 | 2 2 |
| 24 | 28 | 32 | 35 | 38 | 42 | 46 | 50 | 54 | 59 | 2 3 | 8 |

## The reſidue of Aſcentional differences.

| Lat. | 51 | | 51 32 | | 52 | | 53 | | 54 | | 55 | | 56 | | 57 | | 58 | | 59 | | 60 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Deg. | h | m. | h | m. | h | m. | h | m. | h | m. | h | m. | h | m. | h | m. | h | m. | h | m. | h | m. |
| 1 | | 5 | | 5 | | 5 | | 5 | | 6 | | 6 | | 6 | | 6 | | 6 | | 7 | | 7 |
| 2 | | 10 | | 10 | | 10 | | 11 | | 11 | | 11 | | 12 | | 12 | | 13 | | 13 | | 14 |
| 3 | | 15 | | 15 | | 15 | | 16 | | 17 | | 17 | | 18 | | 19 | | 19 | | 20 | | 21 |
| 4 | | 20 | | 20 | | 21 | | 21 | | 22 | | 23 | | 24 | | 35 | | 26 | | 27 | | 28 |
| 5 | | 25 | | 25 | | 26 | | 27 | | 28 | | 29 | | 30 | | 31 | | 32 | | 33 | | 35 |
| 6 | | 30 | | 30 | | 31 | | 32 | | 33 | | 35 | | 36 | | 37 | | 39 | | 40 | | 42 |
| 7 | | 35 | | 35 | | 36 | | 38 | | 39 | | 40 | | 42 | | 44 | | 45 | | 47 | | 49 |
| 8 | | 40 | | 41 | | 41 | | 43 | | 45 | | 46 | | 48 | | 50 | | 52 | | 54 | | 56 |
| 9 | | 45 | | 46 | | 47 | | 49 | | 50 | | 52 | | 54 | | 56 | | 59 | 1 | 1 | 1 | 4 |
| 10 | | 50 | | 51 | | 52 | | 54 | | 56 | | 58 | 1 | 1 | 1 | 3 | 1 | 6 | | 8 | | 11 |
| 11 | | 56 | | 57 | | 58 | 1 | 0 | 1 | 2 | 1 | 4 | | 7 | | 10 | | 13 | | 16 | | 19 |
| 12 | 1 | 1 | 1 | 2 | 1 | 3 | | 6 | | 8 | | 11 | | 13 | | 16 | | 20 | | 23 | | 26 |
| 13 | | 6 | | 7 | | 9 | | 11 | | 14 | | 17 | | 20 | | 23 | | 27 | | 30 | | 34 |
| 14 | | 12 | | 13 | | 14 | | 17 | | 20 | | 23 | | 27 | | 30 | | 34 | | 38 | | 42 |
| 15 | | 17 | | 19 | | 20 | | 23 | | 27 | | 30 | | 34 | | 37 | | 42 | | 46 | | 51 |
| 16 | | 23 | | 25 | | 26 | | 29 | | 33 | | 37 | | 41 | | 45 | | 49 | | 54 | | 59 |
| 17 | | 29 | | 30 | | 32 | | 36 | | 39 | | 44 | | 48 | | 52 | | 57 | 2 | 2 | 2 | 8 |
| 18 | | 35 | | 36 | | 38 | | 42 | | 46 | | 51 | | 55 | 2 | 0 | 2 | 5 | | 11 | | 17 |
| 19 | | 41 | | 42 | | 45 | | 49 | | 53 | | 58 | 2 | 3 | | 8 | | 14 | | 20 | | 26 |
| 20 | | 47 | | 49 | | 51 | | 56 | 2 | 0 | 2 | 5 | | 11 | | 16 | | 22 | | 29 | | 36 |
| 21 | | 53 | | 55 | | 58 | 2 | 2 | | 8 | | 13 | | 19 | | 25 | | 32 | | 39 | | 47 |
| 22 | 2 | 0 | 2 | 2 | 2 | 5 | | 10 | | 15 | | 21 | | 26 | | 34 | | 41 | | 49 | | 58 |
| 23 | | 6 | | 9 | | 12 | | 17 | | 23 | | 29 | | 36 | | 43 | | 51 | 3 | 0 | 3 | 9 |
| 24 | | 13 | | 16 | | 19 | | 25 | | 31 | | 38 | | 45 | | 53 | 3 | 2 | | 11 | | 22 |

Of

## CHAP. VII.

### *Of the civill day, and the manner of finding a day naturall, together with the riſing and ſetting of the Sun, or any Star not exceeding 24 degrees of Declination, perſpicuouſly exhibited from the Table entitituled* [A Table of Aſcentional differences] *referring to all places included between the Equator, and 60 degrees of North or South Latitude.*

A Day Civill is defined to be the revolution of the whole Æquinoctiall Circle, and moreover ſuch a part as the *Sun* in that interim meaſureth by his proper motion, the whole time being reckoned for the ſpace of 24 hours: hence is evident the true genuine cauſe why the fixed Stars do every day come ſooner to the Meridian: for ſuppoſing them ſo many fixed points, it happeneth that the *Sun*, or Earth if you pleaſe, leaving that point or ſtar upon the Meridian, returneth to the ſame again by one revolution, which is ſo much leſſe then 24 hours, as the time that the *Sun* moveth in that interval is above the whole circumvolution, which exceſſe may without ſcruple be conſtantly 4 minutes for a day civill, by which the ſtars doe every day citiate their culmination.

A day naturall is either equall or unequall, equall, to thoſe in a right ſphære, to whom the Æquinoctial is alwayes vertical; unequal, to thoſe

In an oblique ſphære, whoſe vertical point is removed from the Equator, to both, it is the interval of time that the *Sun* continueth above the Horizon, which to the firſt is alwayes twelve hours, to the latter but twice in the year, and that when the *Sun* entreth the firſt ſcruple of *Aries* or *Libra*; at other times it admits of as many dimenſions as there are ſeveral vertical points, all which are accurately known by the peculiar Table as followeth.

To the Meridian of the day propoſed calculate the *Suns* true place, to which get the Declination (by the proper Table) with the note of N. or S. this ſeek in the firſt left hand Column, and your Latitude in the front, from which deſcending, untill that Column meet with a line drawn from the Declination, at which interſection there appeareth the number of the Aſcentional difference, noted by Min. or Hours and Min. which adde to ſix hours if the Declination be N. but ſubſtract if S. and the Sum or deduction doubled ſhall deſigne the length of the day natural, which ſubſtracted from 24 hours, ſheweth the length of the Night, likewiſe if the foreſaid ſum or deduction being the Semidiurnal arch be ſubſtracted from twelve hours there emergeth the riſing, but if added, the ſetting of the *Sun*; otherwiſe the Aſcen. difference is the time that the *Sun* riſeth before 6. and ſetteth after, when the Declination is N. or the time of his riſing after, or ſetting before 6. when S. to illuſtrate all which, take one Example: let it be required to find the premiſes upon the fourth of *May*, *Ann* 1657. at what time the *Sun* being upon the Meridian at *London* poſſeſſeth the 24 d. 1 m. of ♉, the Declination whereof is 18 de. 50 min. N. which found in the firſt left hand Col. & deſcending from the Latitude of 51 d. 32 m. the common angle (after proportional allowance) directeth to 1 ho. 42 min. the Aſc. difference, which added to 6 ho. becauſe the Declination is N. giveth 7 ho. 42 mi. this doubled maketh 15 ho. 24 min. the continuance of the *Sun* above the Horizon, this ſubſtracted from 24 ho. leaveth 8 ho. 36 min. under the Horizon. Againe, if 7 ho. 42 min. be deducted from 12 ho. there emergeth 4 ho. 18 mi. the *Suns* riſing, if added, 7 ho. 42 mi. his ſetting; otherwiſe the *Sun* riſeth 1 ho. 42 min. before, and ſetteth 1 ho. 42 min. after 6. Note it is more rational to compute the *Suns* place to the eſtimate time of his riſing and ſetting, although the former be be prefer'd for expedition.

In order to find the riſing, ſetting and Diurnal arch of a ſtar, it is neceſſary that the time of his culminating be firſt obtained from the ſubſequent Chapter, afterward the operation is common with the *Sun*; for Example, let *Syrius* the great dog-ſtar ✱ be propoſed to enquire his riſing, &c. at *London* for the ſixth day of *January Anno* 1657. By the Table entituled [A Table of the Right Aſcention and Declination of ſome of the moſt noted fixed Stars] his Declination is 16 d. 13 m. S. therefore his Aſcentional Difference by the proper upon Table 1 h. 26 m. which deducted from 6 h. becauſe the Declination is ſo, the reſidue is 4 ho. 34 min. the Semidiurnal Arch, which taken from 10 ho. 34 min. (the time of his culmination collected from the next Chap.) the remainder is 6 h. the time of his riſing, but added, his ſetting, *viz.* 15 ho. 8 min. that is three a clock and 8 min. next morning: otherwiſe the ſaid Star riſeth 4 ho. 34 min. before and ſetteth 4 h. 34 min. after 10 h. 34 min. at night, the time aforeſaid. Finally, if 4 ho. 34 min. be doubled there appeareth the whole continuance above the Horizon, *viz.* 9 ho. 8 min. and this in the Latitude of *London.*

## CHAP. VIII.

### *The Uſe of the Table entituled (A Table of the Right Aſcention of, &c.) for the exact and ſpeedy finding the time when any fixed Star (whoſe Right Aſcention is known) ſhall come to the Meridian. Alſo by the mutuall help of the Table of Aſc. differences to compute Tables of the Oblique Aſcention for all points of the Eclipticke, and this for any Latitude not exceeding 60 degrees.*

IN the uſe of the Table take this caution; that when the R. Aſc. is required to any degree of thoſe Signes in the two extream Columns at the head and foot, then muſt be added 12 ho. (there noted) to the ho. and min. correſponding to that Sign and Degree: thus upon the 6 of *January An.* 1657.

## A Table of the Right Aſcention of every degree in the Ecliptique.

| | ♎ | | ♏ | | ♐ | | Adde 12 hours. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ♈ | | ♉ | | ♊ | | h | m | h | m | h | m | |
| 1 | 0 | 4 | 1 | 55 | 3 | 56 | 8 | 9 | 10 | 8 | 12 | 0 | 30 |
| 2 | 0 | 7 | 1 | 59 | 4 | 0 | 8 | 5 | 10 | 5 | 11 | 56 | 29 |
| 3 | 0 | 11 | 2 | 3 | 4 | 4 | 8 | 0 | 10 | 1 | 11 | 53 | 28 |
| 4 | 0 | 15 | 2 | 7 | 4 | 8 | 7 | 56 | 9 | 57 | 11 | 49 | 27 |
| 5 | 0 | 18 | 2 | 11 | 4 | 12 | 7 | 52 | 9 | 53 | 11 | 45 | 26 |
| 6 | 0 | 22 | 2 | 15 | 4 | 16 | 7 | 48 | 9 | 49 | 11 | 42 | 25 |
| 7 | 0 | 26 | 2 | 19 | 4 | 21 | 7 | 44 | 9 | 45 | 11 | 38 | 24 |
| 8 | 0 | 29 | 2 | 23 | 4 | 25 | 7 | 39 | 9 | 41 | 11 | 34 | 23 |
| 9 | 0 | 33 | 2 | 26 | 4 | 29 | 7 | 35 | 9 | 37 | 11 | 31 | 22 |
| 10 | 0 | 37 | 2 | 30 | 4 | 33 | 7 | 31 | 9 | 34 | 11 | 27 | 21 |
| 11 | 0 | 40 | 2 | 34 | 4 | 38 | 7 | 27 | 9 | 30 | 11 | 23 | 20 |
| 12 | 0 | 44 | 2 | 38 | 4 | 42 | 7 | 22 | 9 | 26 | 11 | 20 | 19 |
| 13 | 0 | 48 | 2 | 42 | 4 | 46 | 7 | 18 | 9 | 22 | 11 | 16 | 18 |
| 14 | 0 | 52 | 2 | 46 | 4 | 51 | 7 | 14 | 9 | 18 | 11 | 12 | 17 |
| 15 | 0 | 55 | 2 | 50 | 4 | 55 | 7 | 9 | 9 | 14 | 11 | 8 | 16 |
| 16 | 0 | 59 | 2 | 54 | 4 | 59 | 7 | 5 | 9 | 10 | 11 | 5 | 15 |
| 17 | 1 | 3 | 2 | 58 | 5 | 3 | 7 | 1 | 9 | 6 | 11 | 1 | 14 |
| 18 | 1 | 6 | 3 | 2 | 5 | 8 | 6 | 56 | 9 | 2 | 11 | 57 | 13 |
| 19 | 1 | 10 | 3 | 6 | 5 | 12 | 6 | 52 | 8 | 58 | 11 | 54 | 12 |
| 20 | 1 | 14 | 3 | 10 | 5 | 16 | 6 | 48 | 8 | 54 | 11 | 50 | 11 |
| 21 | 1 | 18 | 3 | 14 | 5 | 21 | 6 | 44 | 8 | 50 | 10 | 46 | 10 |
| 22 | 1 | 21 | 3 | 18 | 5 | 25 | 6 | 39 | 8 | 46 | 10 | 42 | 9 |
| 23 | 1 | 25 | 3 | 22 | 5 | 29 | 6 | 35 | 8 | 42 | 10 | 39 | 8 |
| 24 | 1 | 29 | 3 | 26 | 5 | 34 | 6 | 30 | 8 | 38 | 10 | 35 | 7 |
| 25 | 1 | 33 | 3 | 30 | 5 | 38 | 6 | 26 | 8 | 34 | 10 | 31 | 6 |
| 26 | 1 | 36 | 3 | 35 | 5 | 43 | 6 | 22 | 8 | 29 | 10 | 27 | 5 |
| 27 | 1 | 40 | 3 | 39 | 5 | 47 | 6 | 17 | 8 | 25 | 10 | 24 | 4 |
| 28 | 1 | 44 | 3 | 43 | 5 | 51 | 6 | 13 | 8 | 21 | 10 | 20 | 3 |
| 29 | 1 | 48 | 3 | 47 | 5 | 56 | 6 | 9 | 8 | 17 | 10 | 16 | 2 |
| 30 | 1 | 52 | 3 | 51 | 6 | 0 | 6 | 4 | 8 | 13 | 10 | 12 | 1 |
| | h | m | h | m | h | m | ♋ | | ♌ | | ♍ | | |
| | Adde 12 hours. | | | | | | ♑ | | ♒ | | ♓ | | |

1657. the *Sun* being upon the Meridian poſſeſſeth the 27 d. 0 m. of ♑, with which entring the Table, the number found is 7 ho. 56 min. to which adding 12 hours the aggregate ſheweth 19 hours 56 min. the R. Aſc. at that inſtant.

To apply this to our preſent purpoſe firſt mentioned: find the R. Aſc. of the given ſtar, in the Table entituled [A Table of the R. Aſc. and Declination of ſome &c. alſo of the *Sun*, as above is taught, which deduct from the R. Aſc. of the ſaid ſtar (but if ſubſtraction cannot be made, firſt adde 24 hours) and the remainder ſhall manifeſt the time to be accounted after noon, which if more then 12 ho. the exceſſe is the time after midnight.

To make this obvious, ſuppoſe *Syrius*, whoſe Right Aſc. from the foreſaid Table is 6 ho. 30 m. the R. Aſc. of the *Sun* $19^h$ $56^m$. $w^{ch}$ deducted from $30^h$ $30^m$ (the ſum of the R. Aſc. of the ſtar and 24 h.) the remainder is 10 ho. 34 min. after noon. Hence I conclude that *Syrius* is exactly South (under the Meridian of *London*) upon the 6 day of *January*, 1657. 34 min. after ten a clock at night. Here note that the eſtimate time of the riſing, ſetting, and culminating, is to be preferred as moſt conſentaneous to verifie: to which the place of the *Sun* ſhould be calculated. Laſtly to obtain the Ob. Aſc. of any deg. of the Ecliptiq. there needeth no further direction, then by this and the precedent Chapter, to enumerate the R. Aſc. and Aſcentional difference to the Sign and Degree deſired, which found, deduct the Aſcentional difference from the R. Aſc. if the Declination be N. but adde them if S. and the Sum or difference ſhall diſcover the oblique Aſc. agreeing to the propoſed Elevation: to explain this by Example, admit the *Suns* place be 29 deg. of ♉, then will the Declination be 20 de. N. the Right Aſcention 3 h. 47 min. and by the Declination the Aſc. Diff. in the Latitude of *London* 1 ho. 49 min. which deducted from the R. Aſc. leaveth 1 ho. 58 min. for the oblique Aſc. Finally, if 1 ho. 49 min. be added to 15 47 the R. Aſc. of 29 deg. of ♏ the ſign oppoſite, again ſubſtracted from 8 ho. 13 min. the R. Aſc. of 1 deg. of ♌, and added to the R. Aſc. of his oppoſite, viz. 20 ho. 13 m. for one deg. of ♒, there is evident the oblique Aſc. to thoſe ſeveral points, viz. for 29 d. ♏ 17 ho. 36 m. for 1 ♌ 6 ho. 24 m. for 1 ♒ 22 h. 2 m. all which may be transferred into a Table, and inſerted againſt their reſpective degrees.

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## Chap. IX.

### *A general Method for erecting a Scheam of the Heavens according to the moſt rational way, and this to any latitude not exceeding 60 deg.*

IN regard the rationall Table of the Houſes is not the leaſt Directory to this Propoſition, it will not be unreaſonable to premiſe a briefe explanation in order to the enſuing uſe. It conſiſteth of five Columns, whereof the firſt towards the left hand containeth degrees of Latitude beginning at 1 and ending at 30. to each of which in the ſecond and fourth Column anſwer other degrees of the Poles Elevation, and therefore called Polary Numbers: but if thy Elevation exceed 30 d. then ſeek the Polary Number in the ſecond or fifth Column, directly againſt that degree in the firſt Column, which with 30 d. maketh the Latitude propoſed; and there is given a number ſubſtituted for the diſcriminating of thoſe houſes ſignified in the front of the peculiar Columns.

It remaineth now to ſhew the manner and form of erecting a figure of the 12 Cœleſtial Houſes, which according to the general received opinion are ſo many ſpaces, comprehended betwixt the arches of great Circles, dividing the Equinoxial into equal parts, and concurring in the mutual interſections of the Meridian and Horizon: thus by conſequence the foreſaid Circles will divide the ſignifer into 12 unequall ſections, every of which being the Cuſpis of a houſe we are now to indigit.

Firſt, to the time given, calculate the true place of the Sun, and by that his R. Aſc. to which adding the foreſaid time reckoned after noon, the aggregate, if leſſe then 24 ho. otherwiſe the overplus ſheweth the R. Aſc. of the *Medium Cœli*, which ſought in the area of the Table of the R. Aſc. the correſpondent ſigne, degree, &c. ſheweth the Cuſp of the tenth houſe, the *Medium Cœli* or point culminating.

Secondly, Adde to the R. Aſc. of the *M. Cœli* 2 ho. and the ſum ſhall be the oblique Aſc. of the 11th houſe; in like order by the continual addition of 2 hours for every houſe you may ſuppute the oblique Aſc. to the begin-

*A Rational Table of the Houſes.*

| Latitude inc. | Polarie num. of the 11 & 3 houſe | | Polarie num. of the 12 & 2 houſe | |
|---|---|---|---|---|
| | 0 | 30 | 0 | 30 |
| 1 | 0 | 16 | 1 | 27 |
| 2 | 1 | 17 | 2 | 28 |
| 3 | 1 | 18 | 3 | 29 |
| 4 | 2 | 19 | 3 | 30 |
| 5 | 2 | 25 | | 31 |
| 6 | 3 | 20 | 5 | 32 |
| 7 | 4 | 21 | 6 | 33 |
| 8 | 4 | 21 | 7 | 34 |
| 9 | 5 | 22 | 8 | 35 |
| 10 | 5 | 23 | 9 | 36 |
| 11 | 6 | 23 | 10 | 37 |
| 12 | 6 | 24 | 10 | 38 |
| 13 | 7 | 25 | 11 | 39 |
| 14 | 7 | 26 | 12 | 40 |
| 15 | 8 | 27 | 13 | 41 |
| 16 | 8 | 27 | 14 | 42 |
| 17 | 9 | 28 | 15 | 43 |
| 18 | 9 | 29 | 16 | 44 |
| 19 | 10 | 30 | 17 | 45 |
| 20 | 10 | 31 | 17 | 46 |
| 21 | 11 | 32 | 18 | 47 |
| 22 | 11 | 33 | 19 | 48 |
| 23 | 12 | 34 | 20 | 49 |
| 24 | 13 | 35 | 21 | 50 |
| 25 | 13 | 36 | 22 | 51 |
| 26 | 14 | 37 | 23 | 52 |
| 27 | 14 | 38 | 24 | 53 |
| 28 | 15 | 39 | 25 | 54 |
| 29 | 15 | 40 | 26 | 55 |
| 30 | 16 | 41 | 27 | 56 |

ning of the other four oriental houſes, of which three are above the Horizon, *viz.* 10, 11, 12, and three under, *viz.* 1,2,3.

Finally, by the given Latitude, find the Polarie Number (which is nothing elſe but the elevation of the Pole above any of thoſe Circles, determining the 12 houſes, meaſured from a great circle drawn from the Pole, and falling at right angles upon the foreſaid circle) to the 11 and 3 houſe, likewiſe to the 12 and ſecond houſe; but for the firſt houſe called the Aſcendent, Horoſcope &c. the given Latitude is ſufficient; to which, and the two Polarie numbers for the foreſaid houſes, compute particular Tables of Ob. Aſc. to every degree of the Zodiacke, according to the inſtitution delivered in the laſt Chapter: and in that Table appropriated to the houſe of which you would know his Cuſp, enter with its oblique Aſc. and the ſign and degree, &c. anſwering thereunto ſhall denote the point deſired, whoſe oppoſite is the Cuſp of his oppoſite houſe, *viz.* 10 againſt 4, 11 and 5, 12 and 6, 1 and 7, 2 and 8, 3 and 9. for illuſtration ſake we will here ſubjoyn one example, and inſert the work in a Scheam.

Let it be required to erect a Figure of the Heavens upon the ſixth day of *January, Anno* 1657. at 10 ho. 32 min. after noon, at what time *Syrius* of the great dog will be preciſely upon the Meridian; to this moment, the *Suns* place is 27 de. 27 min. ♑ whoſe R. Aſc. is 19 ho. 58 mi. to which adding 10 ho. 32 mi. the time after noon, the collect ſum is

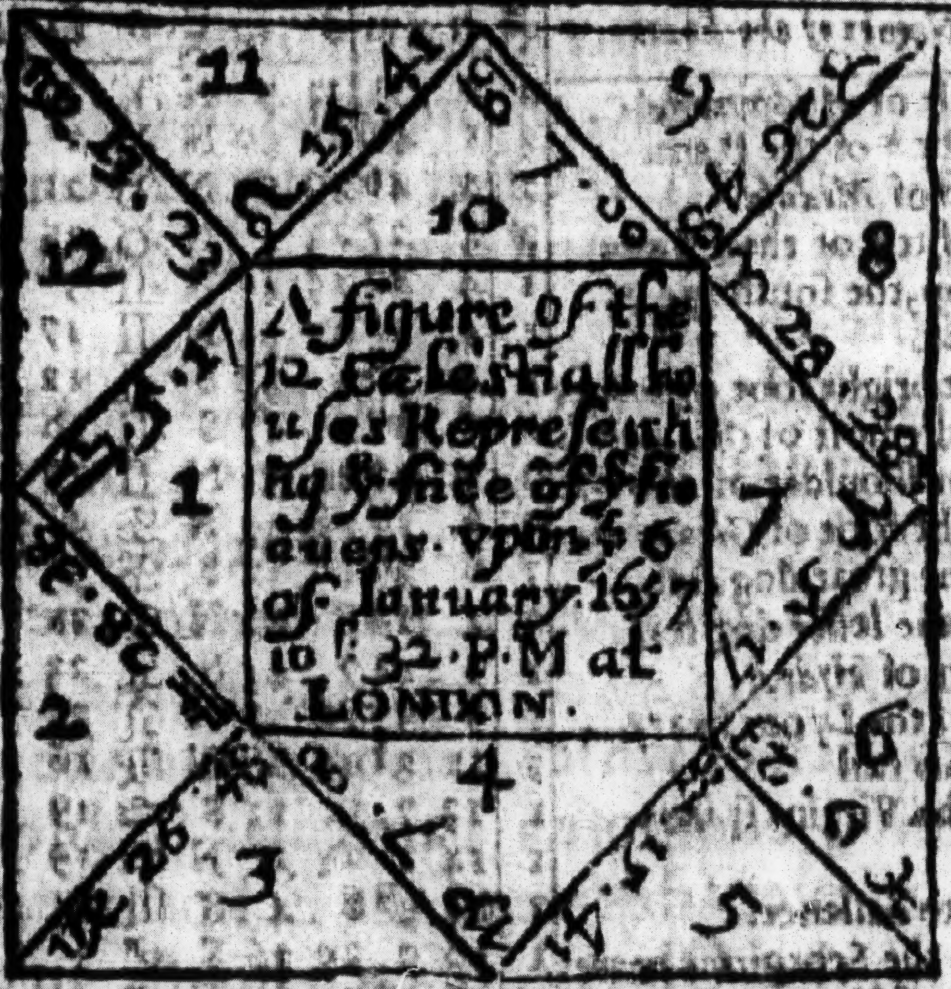
30 h. 30 mi. from which deducting 24 ho. the reſidue ſhall manifeſt the R. Aſc. of *M.C.* *viz.* 6 ho. 30 min. which ſought in the Table of the R. Aſc. ſheweth in the collateral Column 7 d. ♋ for the Cuſp of the tenth houſe, and is the point culminating.

Moreover, adde 2 ho. to 6 ho. 30 min. the R. Aſc. of *M. C.* and the aggregate 8 ho. 30 min. is the Oblique Aſc. of eleventh houſe, but if 4 h. be added, then the Ob. Aſc. of the 12 houſe, *viz.* 10 h. 30m. thus by the ſuperaddition of 2h, 30m, you may produce the Ob. Aſc. of the other houſes, *viz.* for the next in order, the firſt houſe or Aſcendent 12 h. 30 m. for the ſecond houſe 14 h. 30 m. for the third houſe 16. 30.

To conclude, enter the Rational Table with the given Latitude; admit for *London* 51 de. 32 min. againſt which (as by the former direction) is found 32 de. 32 min. the Polarie number for the 11 and and 3 houſe, alſo 47 de. 32 min. for the 12 and 2 houſe, to each of which numbers, and the degrees of Latitude, compoſe a particular Table for the Ob. Aſc. of every degree of the Ecliptique, and entring with the Ob. Aſc. of each houſe, in the area of his peculiar Table, there is given the Cuſpides of the Oriental houſes, in manner as followeth, every of which you may inſert in a Figure of the Heavens, having regard to place the Cuſp of each houſe in his proper angle.

This

| Polarit Numb. | | Hou. | Ob. Aſcentions | | S. D. M. | | | | Hou. | S. D. M. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | M | 10 | 6 | 30 | ♋ | 7 | 00 | | 4 | ♑ | 7 | 00 |
| 32 | 32 | 11 | 8 | 30 | ♌ | 15 | 41 | The Signs and degrees oppoſite are the cuſpides of the other 6 Occidentall houſes | 5 | ♒ | 15 | 41 |
| 47 | 32 | 12 | 10 | 30 | ♍ | 13 | 23 | | 6 | ♓ | 13 | 23 |
| 51 | 32 | 1 | 12 | 30 | ♎ | 5 | 17 | | 7 | ♈ | 5 | 17 |
| 47 | 32 | 2 | 14 | 30 | ♎ | 28 | 38 | | 8 | ♈ | 28 | 38 |
| 32 | 32 | 3 | 16 | 30 | ♏ | 26 | 48 | | 9 | ♉ | 26 | 48 |


A figure of the 12 Celeſtiall houſes Repreſenting y face of the heavens upon 6 of January 1657 10 h 32 P M at LONDON.
10
11
12
1
2
3
4
5
6
7
8
9
♋ 7 00
♌ 15 41
♍ 13 23
♎ 5 17
♎ 28 38
♏ 26 48
♑ 7 00
♒ 15 41
♓ 13 23
♈ 5 17
♈ 28 38
♉ 26 48

Thus by the precedent Method you may frame a Table ſhewing the Cuſpis of each houſe to every 4 m. of time, by which all the aforeſaid will be obtained with much more celerity: if the degrees of Polarit Numbers, given in the Rational Table anſwer not to that exactneſs thou requireſt, conſult the 12 Prob. of the 12 Chap.

A

## *A Table of the Right Aſcention and Declination of ſome of the moſt noted fixed Stars, together with their Longitude and Latitude, calculated for the Yeare 1660. but uſefull alſo for ſome enſuing Yeares.*

| *The Names of the Stars.* | Magn. | R. Aſ. h | R. Aſ. m | Decli. d | Decli. m | Poſit. | Longitud. ♈ | Longitud. D | Longitud. M | Latit. d | Latit. m | Poſit. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| The girdle of *Andromeda*. | 2 | 0 | 51 | 33 | 52 | N | ♈ | 23 | 39 | 25 | 59 | N |
| The bright * of the Ram. | 3 | 1 | 48 | 21 | 50 | N | ♉ | 2 | 56 | 9 | 57 | N |
| The head of *Meduſa*. | 3 | 2 | 46 | 39 | 35 | N | ♉ | 21 | 27 | 22 | 22 | N |
| The brighteſt of the *Pliades* | 3 | 3 | 27 | 23 | 1 | N | ♉ | 25 | 14 | 4 | 0 | N |
| *Aldebaran*, the ſouth eye ♉. | 1 | 4 | 17 | 15 | 46 | N | ♊ | 5 | 3 | 5 | 31 | S |
| The Goat. | 1 | 4 | 51 | 45 | 35 | N | ♊ | 17 | 6 | 22 | 51 | N |
| *Rigel*, the bright foot of *Orion*. | 1 | 4 | 58 | 8 | 38 | S | ♊ | 12 | 7 | 31 | 11 | S |
| The middlemoſt of *Orio*, belt | 2 | 5 | 19 | 1 | 27 | S | ♊ | 18 | 44 | 24 | 31 | S |
| The right ſhoulder of *Auriga*. | 2 | 5 | 35 | 44 | 51 | N | ♊ | 26 | 42 | 21 | 27 | N |
| The bright foot of *Gemminis*. | 2 | 6 | 18 | 16 | 39 | N | ♋ | 4 | 21 | 6 | 48 | S |
| *Syrius*, the great dog ſtar. | 1 | 6 | 30 | 16 | 13 | S | ♋ | 9 | 35 | 39 | 30 | S |
| *Procyon*, the leſſer dog ſtar. | 2 | 7 | 22 | 6 | 6 | N | ♋ | 21 | 8 | 15 | 57 | S |
| The heart of *Hydra*. | 1 | 9 | 12 | 7 | 4 | S | ♌ | 22 | 36 | 22 | 24 | S |
| *Baſiliſcus*, the Lyons heart. | 1 | 9 | 50 | 13 | 37 | N | ♌ | 25 | 7 | 0 | 26 | N |
| The Lyons tail | 1 | 11 | 32 | 16 | 28 | N | ♍ | 16 | 13 | 12 | 58 | N |
| *Ariſta*, the Virgins ſpike | 1 | 13 | 7 | 9 | 21 | S | ♎ | 19 | 6 | 1 | 59 | S |
| *Arcturus* | 1 | 14 | 1 | 21 | 0 | N | ♎ | 19 | 49 | 31 | 2 | N |
| The North ballance. | 2 | 14 | 59 | 8 | 4 | S | ♏ | 14 | 38 | 8 | 35 | N |
| *Antares*, the Scorpions heart. | 1 | 16 | 9 | 25 | 36 | S | ♐ | 5 | 3 | 4 | 27 | S |
| The head of *Hercules*. | 3 | 16 | 59 | 14 | 51 | N | ♐ | 11 | 21 | 37 | 25 | N |
| The bright * of the Harp | 1 | 18 | 26 | 38 | 30 | N | ♑ | 10 | 33 | 61 | 47 | N |
| The bright * of the Vulture | 2 | 19 | 34 | 8 | 1 | N | ♑ | 26 | 59 | 29 | 21 | N |
| The Swans tail. | 2 | 20 | 30 | 44 | 7 | N | ♓ | 0 | 44 | 59 | 56 | N |
| The mouth of *Pegaſus*. | 3 | 21 | 28 | 8 | 21 | N | ♒ | 27 | 12 | 22 | 8 | N |
| *Fomahant*, | 1 | 22 | 38 | 31 | 21 | S | ♒ | 29 | 1 | 21 | 0 | S |
| *Scheat*. | 2 | 22 | 48 | 26 | 16 | N | ♓ | 24 | 39 | 31 | 7 | N |
| The head of *Andromeda*. | 2 | 23 | 51 | 27 | 15 | N | ♈ | 9 | 37 | 25 | 42 | N |

The Longitude of the fixed *Stars* inſerted in the precedent Table, may be exactly rectified to any year given, by adding for every year to their places 50 ſec. and every 100 years 1 d. 23 m. their Latitude remaineth the ſame to ſucceeding ages, being deprehended by modern obſervations to vary little or nothing. Nevertheleſſe their R. Aſc. and Declinations depending upon both, ſuffer a proportionable mutation, in regard of which the foreſaid Table after certain years will require a new emendation: for the obtaining of which I refer you to the 13 *Pro.* of the 12 Chap.

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## CHAP. X.

### *Of Latitude, or the elevation of the Pole with the manner of finding it by the Meridian Altitude of the Sun or any known Star, compared with their reſpective Declinations.*

Latitude, is an arch of the Meridian intercepted between the Equator, and the verticall point of any place: this is alwayes equall to the Elevation of the Pole above the Horizon, and is found as followeth.

Firſt, if the Declination and complement of the Meridian altitude of the Sun or Star be of one ſpecies or kind, *viz.* both North, or both South, compare them together, and their difference is the

Latitude of the given place South, if the Declination be North, but North if the Declination be South, and this whilſt the Declination is leſſe then the complement of the altitude, but if it exceed the complement of the altitude; then is the Latitude according to the ſpecies of the Declination, North or South.

Secondly, if the declination and complement of the Meridian altitude be of contrary ſpecies or kinde, *viz.* one North, and the other South, adde the declination and complement of the altitude, and the aggregate is the Latitude required, and is of the ſame ſpecies with the declination N. if the declination be N. but S. if the declination be South.

Here note (I ſpeak to the induſtrious Seaman) when you obſerve the complement of the *Suns* altitude by the Back ſtaffe, as that which is moſt proper at Sea, your complement is of the upper virge of the *Sun*, becauſe from thence proceedeth the ſhaddow that interſecteth the Horizontal ſight; wherefore if you deſire exactneſſe, alwayes adde 16 min. the *Suns* ſemidiameter, to the complement found upon the ſtaffe, and you have the complement verified; for further explanation admit one example, wherein we will ſuppoſe our ſelves ſayling in ſome part of *Mar-del-Nort.* between the Iſlands of *Cape Verde*, and the great River of the *Amazones.*

Now having made an obſervation upon the 6 day of *May* when the *Sun* poſſeſſed 26 d. 10 m. ♉.

we found the complement of the *Suns* meridian altitude Northward 10 d. 50 m. to which adding 16 min. the true altitude, complement of the *Suns* Centre 11 d. 6 m. then entring the Table of the *Suns* declination with the degrees of the *Suns* place, we found the declination 19 d. 21 m. North. Theſe things conſider'd, according to the firſt rule for finding the Latitude, we compare the declination and complement of the altitude, and find the difference 8 d. 15 m. the Latitude under which we ſailed, and that nothern, becauſe the declination i North, and exceedeth the complement of of the altitude.

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## CHAP. XI.

### *Of Longitude Terreſtrial, and the manner of obtaining it according to the exacteſt inventions in uſe, together with the conjecturall knowledge of the Poſition of thoſe places whoſe Longitude and Latitude is knowne.*

LOngitude is an arch of the Equator (or any parallel) intercepted between two Meridians of which, one is called the firſt Meridian, and is the *Terminus a quo*, the other is that which paſſeth by the vertix of the given place Eaſtward; but where this firſt Meridian ſhould be, it is not agreed upon by all; for ſome have aſſigned that which paſſeth over the *Canarie* Iſlands; others, that which interſecteth ſome one of the *Azores*, or Weſterne Iſlands, but others, as the *Spaniards* at *Toledo* in the *West Indies*. Notwithſtanding which diverſity there can accrue no errour, ſo that any one of theſe be determined from whence to number the Longitude of the ſame places, whereof the ſite and diſtance is required. Difference of longitude is the foreſaid arch intercepted betweene any two Meridians, the longitude of one being known, the other is manifeſt; for if the unknown be Eaſtward adde the difference to that known, but if Weſtward ſubſtract, and the ſum or reſidue ſheweth the longitude of the place from the firſt Meridian alwayes remembring, if ſubſtraction cannot be made that you firſt adde 360 degrees. I come now to ſhew the invention; firſt, by an Eclipſe of the *Moon*, ſecondly, by ſuch an Inſtrument as being once rectified by the *Sun*, can for ſome convenient ſpace exactly meaſure time by its own motion, as a Watch or Hour-glaſſe; thirdly, by the itinerated diſtance of two places: this laſt however ſubject to great errour by reaſon of obſervations, if long diſcontinued, with an intercourſe of tempeſtuous and contrary wind at Sea, alſo the interpoſition of Woods, Mountains, and indirect wayes by land, is neverthel eſſe moſt practiſed, and according to this we have the ſcituation of our remoteſt diſcoveries.

By an Eclipſe of the *Moon* to obſerve the Longitude; firſt, by an *Ephemerides* calculated to ſome known Longitude, informe your ſelfe of an exact

time

time when an Eclipſe of the *Moon* ſhall happen in that place, which noted, when you pleaſe to make an obſervation at any other place where the *Moon* ſhall be adumbrated above that Horizon; by a Watch, Clocke, Hour-glaſſe, or other inſtrument, adapted to this uſe; obſerve the moment of the *Moons* immerſion, greateſt obſcuration, or emerſion, which if either of them you obſerve agree with the time given by the *Ephemerides*, aſſure your ſelfe, you are under one and the ſame Meridian, where there can be only difference of Latitude; but if you obſerve a difference of time betweene the ingreſſe, middle or ending of the Eclipſe at the ſeverall places, for every hours difference reckon 15 deg. and for every minute 15 m. of a degree to be added after, but ſubſtracted if before the time given by the *Ephemerides*, to or from the longitude for which it was calculated, and the ſum or remainder is your deſire. To explain this I ſhall here preſent you with an experimental obſervation of my own, which I made at my owne houſe, being about 55 miles upon *Rappahanocke* River in *Virginia*, and this by a ſmall Eclipſe of the *Moon*, which happened at *London*, as I collected by *Har. Cœl.* upon the 20 day of *February*, *An.* 1654. the beginning 17 h. 6 m. after noon, the emerſion or ending at 19 h. 23 m. *P.M.* this known, I proceeded as followeth; to the Meridian of the ſame day I rectified my clock by the *Sun*, and the night following (being not carefull to obſerve her ingreſſe) awaited till ſhe had finiſhed her egreſſe, which being exactly obſerved, at the ſame moment I noted the hour by the clocke, and by obſervation of the loſſe of time it made in 24 hours, which I found by correcting it to the Meridian of the next day, found it 14 h. 15 m. but that which gave me full ſatisfaction, and in which I confide as the verified time, was, that at the ſame inſtant I obſerved *Spica Virginis* preciſely upon the Meridian, and the time by computation 14 ho. 13 min. whence I conclude that the true time was at 14 h. 13 m. which ſubſtracted (becauſe ſooner then the emerſion at *London*) from 19 h. 23 m. the end of the Eclipſe at *London*, the reſidue giveth 5 h. 10 m. the difference of Longitude from *London* weſtward, but converted into degrees is 77 d. 30 m. this ſubſtracted from 21 d. 00 m. the Longitude of *London*, ſheweth 303 de. 30 mi. the true longitude of the place where I made this obſervation.

Secondly, by a Watch or Hour glaſſe to inveſtigate the longitude of any Region or City.

In the uſe of either is required, firſt that in equal time they run or move equally, *viz.* that they run not faſter in one hour, then in another; ſecondly, that this motion continue 24 hours, in which is no neceſſity, but much convenience, this ſuppoſed at or neare your departure from ſome known longitude, ſet the Index of your Watch, but if a Glaſſe, turn it alſo when the *Sun* is preciſely upon the Meridian, and afterward with great diligence continue their ſeverall motions without the leaſt intermiſſion, untill you make an obſervation, in which place it is neceſſary you abide, untill the Index point to ſome perfect hour, or your glaſſe be run out, unleſſe by exact hour glaſſes you reckon the time run ſince its laſt turning, which noted, obſerve at the ſame moment by an Æquinoctial Dial, or by the *Suns* altitude, as is taught Chap. 12. Prob. 7. the houre in that place, which if agreeing with your Watch or Glaſſe, you have ſayled North or South, as you may perceive by the latitude; but if otherwiſe differing, ſee the former rule in the like caſe. Here note, that the time given by your Watch or Glaſſe is the time at that place where you ſet them to the Meridian: I ſhall not here trouble you with an example, ſince that the operation differeth not from that preceding.

Thirdly, by the account of the Ships way, or itinerated diſtance in a direct line, to find the longitude of places.

In which, avoiding that more abſtruſe working by a ſphæricall triangle reſolv'd (although the moſt abſolute of all others) deſigned to another place, for the exerciſe of the more diſciplin'd Geographer, I ſhall here only propoſe that which is generally received. By the Geometrical reſolution of the ſides of a right lined, right angled Triangle, which although ſubject to errour in long diſtances may be as ſufficiently uſefull as any other, in regard that moſt of our Forreign and remote Countries have been made known to us by obſervations deduced from this or ſome other inferiour Artifice, which thing I am eaſily convinced of, whenas is dayly ſeen that few of our Navigators uſe other then plain ſayling: admitting this digreſſion, I ſhall as the ground of our proceeding make uſe of the 47 Prob. of *Euclids* firſt book, where it is demonſtrated, that in every rectangle Triangle, the ſquare that is made of the Hypothenuſe is equal to the ſquares made of the Baſe and Perpendicular; therefore if from the ſquare of the Hypothenuſe (or line ſubtending the right angle) you deduct the ſquare of the perpendicular, the ſquare of the baſe is manifeſt. To apply this to our preſent purpoſe, let the Hypothenuſe be the diſtance ſayled upon a direct courſe, the Perpendicular the difference of latitude, the Baſe the difference of longitude, all which to render them more perſpicuous, take one Example, admit the Meridian departed from hath in longitude 14 de. in latitude 50 deg. you ſayle or travell upon a direct courſe 300 miles, and then find your ſelfe in the latitude of 47 d. hence the difference of latitude is 3 deg. which reduced into miles is 180, allowing 60 miles for one degree: the ſquare of the hypothenuſe 90000, the ſquare of the perpendicular or parallel diſtance 32400, which deducted from 90000, there remains 57620, the ſquare of the Meridian diſtance in miles, the ſquare root whereof is 240 miles, and is the difference of longitude, which if at any time you pleaſe to turn into degrees, divide it by halfe the aggregate of miles anſwering to one degree of longitude in both latudes: thus in the ſubſequent Table, the miles agreeing to one degree of longitude in the latitude of 47 d. are 40|92 centeſimes, to one degree in the latitude of 50 d. 38 miles 57 cent. the ſum of theſe is 79 miles 49 cent. or parts of 100, the halfe 39 miles 745 parts of a 1000, by which dividing 240 miles, the quotient is 6 de. 2 mi. the difference of longitude in degrees, which ſubſtracted (becauſe the courſe was weſtward) from 14 d. the longitude of the place ſayled from, the remainder is 7 d. 58 min. the longitude of the ſecond place.

Moreover, if thou ſhalt adde the ſquare of the difference of latitude, unto the ſquare of the difference of longitude, both being firſt converted into miles (by multiplying the difference of latitude by 60, and the degrees of the difference of longitude, by halfe the aggregate of miles agreeing to one degree of longitude in both latitudes) thou haſt the ſquare of the diſtance run, the ſquare root of which is the number of miles in that diſtance; thus by the former example inverted, the diſtance is 300 miles.

Finally, if the ſquare of the difference of longitude be deducted from the ſquare of the diſtance run, the remainder is the ſquare of the difference of latitude, whereof the ſquare root is the difference of latitude in miles, which if divided by 60, the quotient is the ſame in degrees and minutes; it remaineth now that I ſhew how by the known longitude of any City or Region to give a near conjecture in what part of the World ſcituate.

Firſt, if of two places the City or Region whereof you enquire have greateſt Longitude, yet not differing more then 180 de. and alſo greateſt latitude, that City or Region lyeth Eaſt northerly: but if the latitude be leſſe, or the difference of longitude exceed 180 de. then weſt northerly.

Secondly, if of two places, that whereof you enquire have greateſt longitude, but within the compaſſe of 180 deg. difference, and leſſer latitude, that ſecond place in reſpect of the firſt lyeth Eaſt ſoutherly; but if the longitude of the ſecond place be leſſe, or the difference of longitude be more then 180 deg. then weſt ſoutherly in proportion to the difference of longitude and latitude.

*A Table of miles anſwering to one deg. in the ſeveral latitude*

| Deg. | 0 | | 30 | | 60 | |
|---|---|---|---|---|---|---|
| | m. | pa. | m. | pa. | m. | p. |
| 1 | 59 | 99 | 51 | 4 | 29 | 9 |
| 2 | 59 | 9 | 50 | 89 | 28 | 1 |
| 3 | 59 | 9 | 50 | 32 | 28 | [illegible] |
| 4 | 59 | 8 | 49 | 75 | 6 | 3 |
| 5 | 59 | 77 | 49 | 15 | 25 | 3 |
| 6 | 59 | 67 | 48 | 54 | 24 | 4 |
| 7 | 59 | 55 | 7 | 92 | 3 | 45 |
| 8 | 59 | 42 | 47 | 29 | 2 | 5 |
| 9 | 59 | 27 | 46 | 64 | 21 | 50 |
| 10 | 59 | 9 | 45 | 57 | 20 | 52 |
| 11 | 58 | 90 | 45 | 29 | 19 | 5 |
| 12 | 58 | 69 | 44 | 59 | 18 | 54 |
| 13 | 58 | 45 | 3 | 89 | 17 | 55 |
| 14 | 58 | 72 | 43 | 17 | 16 | 54 |
| 15 | 57 | 95 | 42 | 44 | 15 | 5 |
| 16 | 57 | 69 | 41 | 69 | 14 | 5 |
| 7 | 57 | 89 | 40 | 91 | 3 | 50 |
| 18 | 57 | 7 | 40 | 15 | 12 | 2 |
| 19 | 56 | 74 | 39 | 37 | 11 | 45 |
| 20 | 6 | 39 | 35 | 57 | 0 | 42 |
| 21 | 6 | 2 | 37 | 77 | 9 | 39 |
| 22 | 55 | 6 | 36 | 94 | 8 | 35 |
| 23 | 55 | 24 | 6 | 12 | 7 | 32 |
| 24 | 54 | 82 | 35 | 27 | 6 | 27 |
| 25 | 54 | 37 | 34 | 42 | 5 | 24 |
| 26 | 53 | 9 | 33 | 55 | 4 | 19 |
| 27 | 53 | 7 | 32 | 69 | 3 | 1 |
| 28 | 52 | 9 | 3 | 60 | 2 | 9 |
| 29 | 52 | 49 | 30 | 90 | 1 | 5 |
| 30 | 51 | 9 | 30 | 0 | 0 | 0 |

*An Explanation of the Table entituled* [A Table of Miles anſwering, &c.

It conſiſteth of four Columns, of which the firſt are ſeveral degrees of latitude beginning at 1 and proceeding to 30, againſt every of which ſtandeth the miles and decimal parts of a mile anſwering to one degree of longitude in that parallel of latitude; in the front of the third Column ſtandeth 30. and over the fourth Column 60, under which are placed alſo the foreſaid miles, corresponding to that latitude which is given by th aggregate of either of thoſe in the front, and on of the numbers in the firſt Column, directly againſt which ſtandeth in the ſquare area, proceeding from the greater number, the miles of longitude. Fo Example, againſt 20 d. of latitude ſtandeth in the ſecond Column 56 miles, 39 centeſimes of a mile, being the extent of one degree of longitude in that parallel, but if thou deſireſt the ſaid miles in the parallel of 51 deg. ſeek in that Column over which is prefixed 30 de. which wanting 21 de. of 51 de. againſt it in the ſaid Columne you have 37 miles and 77 Centeſimes of a mile; ſo for 80 de. of latitude, you have under 60 de. and againſt 20 d. (which together make 80 d.) in the ſquare angle 10 miles 42 Cent. of a mile.

CHAP.

## CHAP. XII.

*Diſcovereth many excellent Propoſitions in Aſtronomie, performed by trigonometrical proportion, whereby the defect of any the preceding Tables may be ſupplyed and extended to more degrees of latitude as cauſe requireth.*

### Probleme 1.

*To finde the Suns altitude by obſervation of Right or verſed ſhaddow.*

SHaddow is diſtinguiſhed into Right and verſed or contrary; the firſt proceedeth from a body (as a ſtaffe or wall) perpendicularly erected, and extendeth it ſelfe upon a ſuperficies parallel to the Horizon.

The ſecond is from a body parallel to the Horizon, and is projected upon a perpendicular raiſed upon the terreſtrial plain; of this ſort is the ſhaddow falling from the ſtretched forth arms of a man ſtanding upright: For the firſt kind, prepare a ſtaffe exactly ſtraight, which divide into 100 equall parts, to be uſed as followeth; at any time when you deſire the *Suns* height, erect the ſtaffe as aboveſaid, the ſhaddow meaſure by the parts of the ſtaffe, which ſuppoſe 60 the known, the proportion will be.

As the extent of the ſhadow 60 parts,
Co.ar.8,2218488

To *Radius*

So the height of the ſtaffe 100 parts. 2,0000000

To tang. the *Suns* altitude 59d.2m. 10,2218488

Now in regard the ſhadow proceedeth from the higheſt part of the *Suns* body, it is manifeſt that the altitude found is too much by the Semidiameter of the *Sun*, which indifferently may be alwayes 16 minutes, this therefore deducted from 59d.2m. leaveth 58d. 46m. for the true altitude of the *Suns* centre, without reſpect had to refraction and parallax.

Secondly, by contrary ſhaddow to obſerve the *Suns* altitude, provide a ſtaffe exactly ſtraight, and at or near the top affix a *Gnomon* or ſtile, which with the ſtaffe may make a right angle or perfect ſquare; this divide alſo into 100 equall parts, which when you pleaſe to apply to the propoſed uſe, erect the ſtaffe perpendicular to the Horizon, which may beſt be effected by a ſtring or other device faſtned upon the vertix of the ſtaffe, to lift it from the ground, for then it will hang perpendicular, and turning the *Gnomon* to the *Sun* note upon the ſtaffe the number of his parts at the extent of the ſhadow, which for example ſake ſuppoſe 120. theſe given the Analogie will be.

As the extent of the ſhadow 120. co.ar.7,9208188

To *Radius*

So the longitude of the *Gnomon* 100 2,0000000

To tang. the comp. of the *Suns* altitude 9,9208188

39d.

d. 48. which ſubſtracted from 90d. ſheweth in
e reſidue 50d. 12m. the altitude of the loweſt
rge of the *Suns* body, wherefore as before you
bſtracted, ſo now adde 16m. and the altitude of
s centre will be 50d. 28m.

### *Probleme* 2.

*o compute the Suns Altitude, his Declination, and diſtance from the Meridian, together with the Elevation of the Pole being given.*

If the *Sun* be in the Equator, reaſon thus:

As *Radius* co. ar. 0.
To *Co. Sine* the Poles elevat. $38^{d}$. $30^{m}$. 9,8935444
So *C.S.* the hour from noon. 30. 00. 9,9375306
To *C.S.* the co. of the altitude 47.20. 9,8310750

Of which the ſupplement to $90^{d}$. is $42^{d}$. $40^{m}$. the altitude enquired.

If the *Sun* have Declination, the Analagies are, firſt. co. ar.=tang.

As *C.Ta.* the com. of the poles elev. $40^{d}$0. 9,9238135
To *C.S.* the hour from the Merid. 30.0. 9,9375306
So *Radius*
To tang. the firſt arch $36^{d}$,$0^{m}$. 9,8613441

which deducted from the complement of the *Suns* Declination, *viz.* when the *Sun* hath North declination; but when ſouthern, from the aggregate of $90^{d}$. and the *Suns* declination, and the reſidue is the ſecond arch; as in this example, for if $11^{d}$.$31^{m}$. the declination of $0^{d}$. ♏ a ſouthern ſign be added to $90^{d}$. the ſum is $101^{d}$. $31^{m}$. from which if $36^{d}$. $00^{m}$. be ſubducted, the remainder is $65^{d}$. $31^{m}$. for the ſecond arch, this premiſed, ſay,

As *C.S.* the firſt arch found $36^{d}$.$0^{m}$.*co.ar.* 0,0920474
To *C.S.* the ſecond arch, 65. 31. 9,6174496
So *C.S.* the com. of the po. el. 40.00. 9,8842540
To *C.S.* the com. of the *Suns* altitude
($66^{d}54^{m}$.95937460

The complement whereof $23^{d}$.$6^{m}$. is the altitude of the *Sun* at the time aſſigned.

### Probleme 3.

*The altitude of the Sun being known, with the height of any upright body, to find the extent of its ſhadow at any time aſſigned.*

By the converſe of the firſt Probleme, ſay,
As *Ta.* the *Suns* altitude $59^{d}$.$2^{m}$.*co. ar.*---*c ta.*
9,7782012
To the height of the ſtaſſe 100 parts 2,0000000
So *Radius*
To the longitude of the ſhadow 60 parts 1,7782012

By this Analogie you may compoſe a Table ſhewing to every day of the year the ſhadow of any erect *Gnomon* whoſe length is given, agreeing to any hour aſſigned, very uſefull for finding the hour of the day; the like may be done by contrary ſhadow, for if inſtead of the *Suns* altitude, you take the co. Tangent of its complement, and adde to the Logarithme of the Gnomon, the aggregate is a logarithme of the ſhadows extent.

The

## Probleme 4.

*The Suns greateſt Declination given, together with the number of degrees comprehended betwixt the degree of the Suns place in the Ecliptique, and the next Æquinoctial point, to find the Declination to the degree aſſigned.*

Declination, is the *Suns* declining from the Equator towards either pole.

Suppoſe the *Sun* be in 20$^{d}$. 15$^{m}$. ♉. from whence to the vernal Æquinoctial (as being the neareſt) is intercepted 50$^{d}$. 15$^{m}$. which granted, the proportion will be

| | | |
|---|---|---|
| As *Radius* | | *co. arithmetical* |
| To *Si.* the diſtance | 50$^{d}$. 15$^{m}$. | 9,8858370 |
| So *S.* the greateſt declination. | 23 30. | 9,6006997 |
| To *S.* the preſent declinat. | 17. 51 | 9,4865367 |

## Probleme 5.

*The Altitude of the Sun, and diſtance from the Meridian or hour from noon, together with his preſent declination given, to find the Suns Azimuth.*

*Azimuth*, (an *Arabian* word) is an arch of the Horizon, comprehended between the Meridian and a line drawn from the vertical point through the *Suns* centre into the Horizon.

By the *Suns* declination find his diſtance from the North Pole, by deducting the declination from 90$^{d}$. if North; but if South, then by adding the declination to 90$^{d}$, the Sine of whoſe aggregate ſhall be equall to the Sine of an arch, as much beneath 90$^{d}$. as that exceeds, for which reaſon ſubſtraction is ſufficient in both caſes. Hence alſo, if the *Sun* have no declination, his diſtance from the North Pole is 90$^{d}$. admit the declination be 17$^{d}$. 51$^{m}$. North, the Analogie will be

As *S*. the com. of the *Suns* altitude 41$^{d}$. 9$^{m}$. *co. ar.* 0,1817526
To *S*. the hour from noon, 2$^{h}$. or 30$^{d}$. 9,6989700
So *S*. the *Suns* diſtance from the N. Pole 72$^{d}$. 9$^{m}$ 9,9785741
To *S*. the *Azimuth* from the S 46. 19. 9,8592967

The *Azimuth* is of excellent uſe for finding the variation of the compaſſe, whether upon the Sea or Land. To obſerve which take this direction, at the moment when you obſerve the altitude of the *Sun*, with a large compaſſe accommodated to this purpoſe, ſet the *Sun*, the points of the needle being placed directly over the Meridian line; in this poſture note the degree interſected by ſetting the *Sun*, between which and the Meridian, the degrees ſhew the magnetical *Azimuth*, which if correſpondent to the computed *Azimuth*, aſſure your ſelfe the needle hath no variation, but preciſely reſpects both Poles; but if the *Azimuth* calculated exceed, the difference are the degrees of variation from the North pole Eaſterly, and the contrary.

*Prob.* 6.

## Prob. 6.

### *Having the Suns Azimuth, Altitude and Declination, to find the Elevation of the Pole at any time aſſigned.*

To effect this, the Analogie may be, firſt,

| | d. m. | = *tangent* |
|---|---|---|
| As C.T. the com. of *Suns* alt. | 39. 27. *co.ar.* | 9,9153322 |
| To C.S. the *Suns Azimuth* | 47 37. | 9,8287163 |
| So *Radius* | | |
| To T. the firſt arch found | 29.1. | 9,7440485 |
| Secondly, | | |
| As C.S. the com. of *Suns* alt. | 39.27. | *c.a.* 0,1122818 |
| To *C.S.* the *Suns* decl. com. | 69. 47. | 9,5585375 |
| So *C.S.* the firſt arch found | 29.1 | 9,9417492 |
| To *C.S.* the ſecond arch | 66.58. | 9,5925685 |

from which ſubſtract the firſt arch, when the declination is North; as in this Example, the remainder 37$^{d}$. 57$^{m}$. is the complement of the Poles elevation; but if the declination be South, ſubduct the comp. of either arch from the other, and the reſidue ſheweth the latitude of the place: if the *Sun* have no declination the arch found by the firſt Analogie is the enquired latitude.

## Prob. 7.

### *The Poles Elevation, the Suns Declination, and Altitude given, to find the hour of the day.*

***Dat.***

The *Suns* declin.com. $69^{d}.47^{m}$. North.
The *Suns* altitude com.76.46.
The Elevation com. 38.00.
And is the *Suns* diſtance from the N. Pole; but if South, as here, then $110^{d}.13^{m}$.
Diſtance of the *Sun* from N.P. having $110^{d}.13^{m}$.
The Comp. of the Poles Elevation. 38 00
Their difference 72 13
Their halfe difference 36 6 30 ſec
Halfe the *Suns* altitude com. 38 23
Their aggregate 74 29 30
Their difference 2 26 30
Sine the Pol.elevat.com. $38^{d}$. $0^{m}$. *co.ar.*0,2106580
Sine the *Suns* declin.com.*69*.47.*co.ar.* 0,0276155
Sine the agregate as above 74.29.30ſec. 9,9838930
Sine the difference as above 2.16.30 8,2987417
The Sum 18,8209082
Sine the halfe Sum $14^{d}.55^{m}$.*ferè.* 9,4104541
This doubled is $29^{d}.50^{m}$. the *Suns* diſtance from the Meridian, which converted into time by the 1 Chap. is $1^{h}$. $59^{m}$.after noon.

In like manner, if the Declination of a Star, together with his altitude, in a known latitude were given, the hour of the night may be found by the ſame proportion: and having the Stars diſtance from the Meridian (which is the hour of the day in working by the *Sun*) ſubſtract it from the Right Aſc. of the *Medium Cœli*, from which dedu deducting the *Suns* R.Aſc. (alwayes adding the whole Circle if ſubſtraction cannot be made) the reſidue converted into time giveth the houre after noon.

## Prob. 8.

### *Having the Suns Azimuth, Altitude and Declination to find the hour of the day.*

d. m. *co. ar.*

As S. the *Suns* diſt. frõ the N.P. 110. 13. 0,0276155
To S. the *Azimuth* from the South 28. 50. 9,6832843
So S. the com. of the *Suns* altit. 76. 46. 9,9883118
To S. the *Suns* diſtance from the 9,6992116
Meridian, $30^{d}.1^{m}$. *ferè*. in time 2 ho. 0m.

## Prob. 9.

### *Having the Poles Elevation, and the Suns Declination to find his Amplitude.*

The *Suns* Amplitude is an arch of the Horizon intercepted between the riſing or ſetting *Sun*, and either Æquinoctial point.

In this the Analogie may be

As C.S. the elevation $51^{d}.32^{m}$. *co. arith.* 0,2061683
To C.S. the *Suns* declin. com. $69^{d}.47^{m}$. 9,5385375
So *Radius*
To C.S. the com. of the ampl. $56^{d}.15^{m}$. 9,7447058

Which deducted from $90^{d}$ the reſidue $33^{d}.45^{m}$. is the *Suns* Amplitude, northward, becauſe the Sun hath North declination.

The Amplitude is of ſingular uſe for invention of the variation at Sea; for if the Amplitude exceed that obſerv'd by the Compaſſe, the difference is the variation Weſterly, and the contrary.

## Prob. 10.

### *To compute the Suns Right Aſcention.*

The *Suns* Right Aſcention is that degree of the Equator which the Horizon in a direct ſphære interſecteth preciſely at *Sun* riſing.

Admit the *Sun* be in 10 deg. of ♌, therefore diſtant from the next Æquinoctial point ♎ $50^{d}$. $00^{m}$. therefore,

As co. ta. the *Suns* diſtance $50^{d}$.*co.ar.*= *tang.*
10,0761865
To Co.S. the greateſt declin. $23^{d}.31^{m}$. 9,9623428
So *Radius*
To Ta. the R. Aſcention $47^{d}.32^{m}$. 10,0385293

And is from the Æquinoctial point given, which ſubducted from 180 deg. ſheweth in the reſidue 132 deg. 28 min. from the beginning of ♈.

## Prob. 11.

### *The Elevation of the Pole, and declination of the Sun being given, to find the Aſcentionall difference, and conſequently the riſing and ſetting of the Sun.*

The Aſcentionall difference, is the difference between the Right and oblique Aſcention of any degree in the Ecliptique. The firſt being determined in a right ſphære as aforeſaid, the other in an oblique ſphære, and is likewiſe the degree of the Equator riſing with the *Sun*, the proportion is

| | | |
|---|---|---|
| As *Radius* | | co. ar. 0, |
| To tan. the Suns declination, | $15^{d}.00^{m}$. | 9,4355757 |
| So co. ta. the elevation comp. | 38.28. | 10,0999135 |
| To S. the Aſc. difference | 20.4. | 9,5354892 |

In time 1 ho. 20 mi. which (becauſe the Declination is North) ſubſtracted from 6 ho. the remainder is the hour of Sun riſing, but added, his ſetting.

By the R. Aſc. and Aſcentional difference, the Oblique Aſcention may be obtained, as is taught in the 8 Chapter.

### *Prob.* 12.

### *To find the Elevation of the Pole above any Circle of Poſition.*

The Circles of Poſition are counted ſix, and their ſemi-circles are ſuch as dividing the Equator into 12 equal parts, concur in the mutuall interſections of the Meridian and Horizon: conſequent to this it is that the ſemicircles of Poſition divide the Eclipique into as many unequal parts, determining the twelve Houſes of Heaven, and their common interſection, the cuſpis of each houſe, whileſt that the degrees in the Equator intercepted between two ſuch ſemicircles, manifeſt the difference of Aſcentions between two houſes.

Suppoſe it be required to find the altitude of the Pole above the Circle of Poſition, deſigning the 11 or 3 houſe, and this in the Latitude of $51^{d}.00^{m}$. ſay,

As tan. the com. of the latit. $39^{d}$. co.ar. 10,0916308
To Sine, the difference of Aſcentiion between the *M.C.* & the 11 houſe or the *Imum C.* of the 3 ho. } $30^{d}$. 9,6986700
So *Radius*
To co. ta. the com. of the elev. $58^{d}.18^{m}$ 9,7906098
Which deducted from $90^{d}$. ſheweth $31^{d}.42^{m}$. for the altitude or elevation propoſed.

### Prob. 13.

### *Having the Longitude and Latitude of a Star, to find its Right Aſc. and Declination.*

The Longitude of a Star, is an arch of the Ecliptique comprehended between the firſt ſcruple of *Aries*, and a circle drawn from the Pole of the ſignifer, and paſſing by the Star into the Ecliptique.

Latitude, is his diſtance from the Ecliptique towards the North or South Pole of the ſignifer.

Let it be propoſed to find the Declination and Right Aſcention of *Syrius*, or the great Dog ✱, who hath Longitude $9^{d}.25^{m}$. in ♋, and Latitude $39^{d}.30^{m}$. South. Hence his diſtance from the Solſtitial colure 9d.25m. and from the North pole of the ſignifer 129d.30m. the firſt Analogie is.

As c. greateſt dec. 23d.31m. co.ar. —10. 9,6386473
To *C.S.* his diſtance from the next Solſtitial colure } 9d. 25m. 9,9941079
So *Radius*

To tang. the firſt arch 23d. 14m. 9,6327552
Which deducted from 129d. 30m. giveth the ſecond arch 106d. 16m. = equal to 73d. 44m. as appeareth in the fifth *Prob.* ſecondly,
As C.S. the firſt arch 23d. 14m. *co. ar.* 0,0367289
To C.S. the ſecond arch 73. 44. 9,4473259
So C.S. the greateſt decl. 23. 31. 9,9263428
To C.S. the com. of the ſtars dec. 23. 46. 9,446376
Which ſubſtracted from 90d. the relict is 16d. 14m the declination from *Syrius*, from the Equator Southward.

To know whether the Declination be Northward or Southward, take this briefe direction.

If the point of the Ecliptique that the Star poſſeſſeth, and his Latitude be of one ſpecies or kind *viz.* both North, or both South, the declination is of like ſpecies.

If of divers kinds, *viz.* one North, the other South. Conſider whether the Latitude exceed, or be leſſe then the Declination of that point of the Ecliptique: If it exceed, then the declination is of the ſame ſpecies with the latitude: if leſſe, then of the ſame kind with that point of the Ecliptique.

Secondly, for the R. Aſc. the Analogie may be
As S. com. of the * dec. 73d. 46m. *co. ar.* 0,1776694
To S. the forementioned diſt. 9d. 25m. 9,2138176
So S. the *Suns* diſt. 129d. 30m. = 50. 30. 9,8874061
To S. the com. of the R. Aſc. 7d. 33m. 9,1188931
To be reckoned from the neareſt *Æquinoctiall* point, wherefore ſubſtracting it from 90d. the reſidue 82d. 27 m. the R. Aſc. from ♎ (that being

nearest to 9d. 25m. of ♋) but from ♈ 97.33. being the ſupplement of 82d. 27m, to 180d.

### *Prob.* 14.

*To inveſtigate the perpendicular height of the Cloud, by their gradual Altitude obſerved at two ſtations, together with the Itinerarie diſtance of both ſtations given.*

In a day when the Clouds move little or not at all: firſt, prepare two Glaſſes that may run out their ſands in equall time: ſecondly, turn both Glaſſes together, and having made choice of thy ſtation, let thy companion with one of the glaſſes & an Inſtrument for this uſe go a competent ſpace towards the Cloud aſſigned for obſervation: now awaiting the running out of the laſt ſand in both glaſſes (which will be in one and the ſame moment of time) let each in their ſeverall ſtations obſerve the altitude of that part of the Cloud which was mutually agreed upon: thirdly, meaſure the diſtance of the ſtations: theſe prenoted the Analogie followeth.

As S. the difference of the altitudes. 7d 30m. *co. ar.* 0.884302
To the diſt. of the ſtations 480 perches 2,681241
So S. the leſſer altitude 31d. 30m. 9,718085
To 1921 perches. 3,283628

Which is the diſtance of the Cloud and the ſtation at the greateſt altitude. In miles 6. and 1 perch.

Secondly, for the perpendicular height in perches.

As

| | |
|---|---|
| As *Radius* | *co. ar.* 0. |
| To the foreſaid diſtance 1921 perches | 3,2836286 |
| So S. the greateſt altitude $39^{d}.00^{m}$. | 9,7988718 |
| To the height of the cloud 1209 perch. | 3,0825004 |

which if converted into miles is $3\frac{3}{4}$ and 9 perches.

Thirdly, for the diſtance between the ſtation at the greateſt altitude, and the place where the Cloud ſhall be vertical, the Analogie is,

| | |
|---|---|
| As *Radius co. ar.* | 0,00 |
| To the diſtan. firſt found 1921 perches | 3,2836286 |
| So C.S. the greateſt altitude $39^{d}.00^{m}$. | 9,8905026 |
| To 1493 perches | 3,1741312 |

B it converted into miles by allowing 320 perches for one mile is $4\frac{1}{2}$ miles, 53 perches, the diſtance above required.

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## CHAP. XIII.

### *Sheweth the reſolution of many neceſſary Propropoſitions in Coſmographie, particularly applyed to Navigation, and determined by Sphericał Analogie.*

### *Prob. 1.*

### *To find how many miles anſwer to one degree of Longitude in any parallel of Latitude.*

ADde the Sine Complement of the Latitude of the given parallel, to the Logarithme of 60 miles, and the aggregate is a Logarithme whoſe correſpondent number are the miles proportioned to one degree in that parallel; for explanation take one example, being for the Latitude of $51^{d}.32^{m}$.

Co.Sine the latitude of $51^{d}.32^{m}$. 9,7938317
The Logarithme of 60 miles. 1,7781512
The mil. anſwering to $1^{d}$. of lon. $37\frac{32}{100}$. 1,5719829

For if you enter with the Loga. 1,5719829, in the reſpective Table, you have the number of miles ſtanding againſt the neareſt leſſe, *viz.* 37 miles, then changing the characteriſtique into 3, *viz.* 3,5719829. you have correſponding to this laſt Logarithm 3732. which ſheweth in the two laſt figures $\frac{32}{100}$ or | 32 of a mile for the part proportional.

## *Prob.* 2.

### *Having the neareſt diſtance of two places, to find the difference of Longitude*

1. If one place be under the Æquinoctial, and the other in a given latitude, the Analogie will be.

As Co.S. the lutitude $50^{d}.00^{m}$. *co ar.* 0,1919325
To C.S. the neareſt diſtance 70 dgrees 9,5340517
So *Radius*
To C.S. the difference of Lon. $57^{d}.51^{m}$. 9,7259842

Here note that the diſtance between two places is to be reduced into degrees as above, by allowing 60 miles or 20 leagues to one degree, for they are coequal in a great Circle. Chap. 1.

2. If both places be ſituate under the ſame parallels of latitude, the Analogie may be

As S. the cō. of the cōmon lat. 40$^{d}$. *co.ar.* 0,1919325
To S. halfe the diſtance 20 degrees. 9,5340517
So *Radius*
To S. half the difference of lon. 32$^{d}$. 9$^{m}$. 9,7259842
Which doubled is *64*$^{d}$. 16$^{m}$. the difference of longitude.

3. If the places have difference of latitude and ſituate without the Æquinoctial both on the ſame ſide, then

Com. the lat of one place 54$^{d}$. *Si. co.ar.* 0,0920424
Com. the la. of the other pl. 40. *Si. co.ar.* 0,1919325
Difference of latitude 14
Halfe the difference 7
Halfe the diſtance 27 33$^{m}$.
Their aggregate 34 33. *Si.* 9,7536770
Their difference 20 33. *Si.* 9,5453376
The aggregate 19,5829915
Sine the half aggregate 38$^{d}$. 13$^{m}$. 9,7914957
Which doubled is *76*d. 26m. the difference of longitude.

4. If one place have South, and the other North latitude,

The Analogie will in like manner be as the laſt preceding only what Southern latitude one place hath, adde to *90* d. and the aggregate ſhall be inſtead of Com. the latitude, the complement Arith. of which muſt be to the com. of the exceſſe above *90*d. *vide* the fifth and ſeventh *Prob.* of the foregoing Chap.

## *Prob.* 3.

### *The difference of Longitude, and the Latitude of two places given, to find their neareſt diſtance.*

1. If one place be under the Æquinoctial, and the other have north or ſouth latitude.

The propoſition is the converſe of the 1 *Prob.* in the preceding *Prob.*

As *Radius* co.ar. 0,
To *C.S.* the difference of long. 57d. 51m. 9,7259842
So *C.S.* the given latitude 50. 00. 9,8080675
To *C.S.* the neareſt diſtance 70. 00. 9,5340517

Which converted into leagues, by allowing 20 leagues to a degree is 1400 leagues.

2. If both places be ſituate under the ſame parallel of latitude.

The Analogie will be the converſe of the 2 propoſition in the preceding *Prob.* but becauſe the laſt is of the like nature, it is needleſſe to reiterate the operation.

3. If the places have difference of latitude, and lie under two intermediate parallels, between the Æquinoctial and one of the Poles.

First ſay co ar. = tang.
As *C.T.* the cō. of greateſt lat. 38d. 28m. 9,9000865
To *C.S.* the difference of long. 77. 30. 9,3353368
So *Radius*
To tang. the firſt arch found 9. 45. 9,2354233

Which being ſubſtracted from the com. of the leſſer latitude, *viz.* 51d. 30m. the remainder is 41d. 45m. the ſecond arch, therfore

Secondly,
As *C.S.* the firſt arch 9d.45m.*com.arith.* 0,0063187
To *C.S.* the ſecond arch 41.45. 9,8727722
So *C.S.* the co. of greateſt lat. 38d.28m. 9,8937452
To *C.S.* the diſtance 53.39. 9,7728361

Which reduc'd into miles, allowing 60 to one degree is 3219 miles or 1073 leagues.

4. If one place have South, and the other North latitude, then the Analogies will in all reſpects be the ſame as the two laſt, only remember to adde the Southern latitude to 90d. and the aggregate ſhall be inſtead of the com. of that latitude from whence you are to deduct the firſt arch found.

### *Probl.* 4.

### *To find the direct Poſition of one place from another.*

Direct Poſition is the angle included by the Meridian of the place given, and the great circle drawn by both places.

1. If one place be under the Æquinoctial, and the other in a given latitude: to inſtance in one Example, admit it were required to find the direct poſition of the influx of the great River of the *Amazones* from the *Lyzard* and the converſe.

The Analogie may be, *co-ar.=co.ta.*
As *Ta.* the difference of long. 41d. 10,0608369
To *Si.* the difference of latit. 50 9,8842540
So *Radius*
To *Co.Ta.* the poſition 48.37. 9,9450909

And is of the *Amazones* from the *Lyzard, viz.* *S W* 3d. 37m. weſterly: again,

As *ta.* difference of lat. 50d. *co. ar.* = *co. ta.* 9,9238135
To *S.* the difference of long. 41d. 00m. 9,8169429
So *Radius*
To *co. ta.* the com. of poſition. 61. 10. 9,7407564

Whereof the com. is 28d. 50m. the direct poſition of the *Lizard* from the *Amazones* N N E. 6d. 20m. eaſterly.

Hence it is manifeſt, he that would ſayle the neareſt way to the *Amazones* from the *Lizard*, muſt firſt ſhape his courſe *S W.* 3d. 37m. weſt, yet alwayes inclining ſoutherly in proportion to the diſtance and great circle, paſſing by both places, untill he drawing neare to the *Amazones* ſhall vary his courſe *S S W.* 6d. 20m. weſt, which ſhall bring him to the influx of the ſaid River.

But if unacquainted with that onely direct ſayling by a great Circle, thou deſireſt the Heliſphærical courſe, being a line like to the crooked winding of a worm, or Serpent called of Seamen (by a Luſitanian word) the Rumbe: multiply the difference of longitude, by halfe the miles anſwering to a degree of longitude in both latitudes, and reducing the difference of latitude into miles; reaſon thus.

Latitude { *Lyzard* 50d | corrreſpon 38|57
of the { *Amazones* 0. | ding miles 00|00
Difference of lat. 50d. Their aggregate 38|57
60 Halfe aggre. 19|785

Diff. of latitude 3000. difference of longitude in degrees 41 in miles. 19785

79140

Difference of longitude in miles 811|185

As the difference of latit. in miles 3000. *co.ar.*

6,522878

Is to *Radius*

So the differeence af long. in miles 811. 2,909021

To tangent the Rumbe 15d.7m. 9,431899

And is from the *Amazones* to the *Lyzard*, *viz.* *N* by *E*. 3d.52m. eaſterly, but from the *Lyzard* to the *Amazones* the oppoſite Rumbe, *viz.* *S* by *W*. 3d.52m weſterly.

2. If both places be ſituate under one parallel of latitude: to inſtance,

Admit it were required to find the direct poſition of the entrance of *Delaware* bay (between *Virginia* and *New-England*) from *Lyſbone* in *Portugall*, and the converſe.

Dat. Their parallel of latitude 38d.45m.
Their diff. of long. or par. diſt. 68 00

tang.

As *co.ta.* half the diff. of long. 34d. *co.ar.* 9,828987

To *co.ſi.* the com. of the cōmon lat. 51,15. 9,798521

So *Radius*

To *co.tan.* the poſition 67d.7m. 9,625508

And is of *Delaware* bay from *Lyſbone*, *viz.* *W N W. ferè*, and of *Lyſbone* from *Delaware* bay *E N E. ferè.*

Hence it is evident that he which would ſayle from *Lyſbone* to *Delaware* bay, the neareſt way, muſt not ſayle weſt, becauſe under one parallel, but muſt firſt ſhape his courſe *W N W.* alwayes inclining weſterly, untill drawing neare the coaſt ſhall varie to the *W S W.* Likewiſe he that would go from *Delaware* bay to *Lyſbone* muſt firſt ſhape his courſe *E N E.* afterwards eaſterly, as to *E* by *N.* then to the eaſt, next to the *E* by *S.* and laſtly *E S E.* to *Lyſbone*, alwayes remembring that you ſo proportion the diſtance ſayled upon one point, that you keepe under the great circle that paſſeth over the vertical points of both places.

3. If the places have difference of latitude, and lie under two intermediate parallels between the Æquinoctial and one of the Poles.

To inſtance in one Example: ſuppoſe it be required to find the poſition of the Capes of *Virginia* from the *Lyzard* and the converſe.

| | | |
|---|---|---|
| | The mean lat. of both Capes | 37d.00m. |
| *Dat.* | The Latitude of the *Lyzard* | 50 00 |
| | Difference of Longitude. | 70 00 |

*tangent*

| | | |
|---|---|---|
| As *co. la.* the cō. of greateſt lat. 40d. *co. ar.* | | 9,9238135 |
| To *Co. S.* the difference of long. 70. | | 9,5340517 |
| So *Radius* | | |
| To *tang.* the firſt arch | 16.1m. | 9,4578652 |

Which ſubſtracted from the com. of the leaſt Latitude, *viz.* 53d. there remaines 36d.59m. for the ſecond arch.

Then for the poſition of the *Lyzard* from the Capes, the Analogie may be

| | |
|---|---|
| As *S*. the firſt arch 16d. 1m. *com*.*ar*. | 0,5592216 |
| To *S*. the ſecond arch 36.59. | 9,7792953 |
| So *C*. *Ta* the difference of long: 70d. | 9,5610659 |
| To *co*.*ta* the poſition 51d. 34m. | 9,8995828 |

And is of the *Lyzard* from the Capes, *viz*. N E. 6d. 34m Eaſterly.

Moreover, if inſtead of the Complement of the greateſt Latitude, you take the *com*: of the leſſer, and work according to the firſt of the preceeding Analogies, you have the firſt arch 24d. 25m. to be taken from the *com*: of the greater latitude, *viz*: 40d and there remains the ſecond *arch*: *viz*: 15d. 35m. by both which, and the difference of Longitude, you have the poſition given by the laſt of the foreſaid Analogies. *viz*: 76d. 42m. *W*. by *N*. 2d. 3m. Northerly. So then if thou wilt ſayle to *Virginia* the ſhorteſt way. Firſt ſayle *W* by *N*. 2d. 3m. North, ſtill inclining to the Weſt proportionable to the great Circle under which you ſayle, and as you approach nearer the end of the voyage, to the ſouthward of the Weſt, as Weſt by *S*. then *W*.*S*.*W*. then *S*.*W*, by *W*. and laſtly 4d. 41m. more ſoutherly untill you fall in with the Capes. Alſo if you be bound from the Capes to the *Lyzard*. Firſt ſhape your courſe *N*.*E*. 6d. 34m. Eaſterly, alwayes bending by little and little to the Eaſtward (and this in proportion to the arch of the great Circle under which you ſayle) untill your laſt courſe be E. by *S*. 2d. 3m. ſoutherly. Here note when you ſayle by the arch of a great Circle, it is more convenient, that near the end of your voyage you keep the parallel of the place whereunto you intend.

4 If one place have South Latitude, and the other North Latitude.

The Analogies will in all reſpects be like the two laſt mentioned, ſtill remembring that you add 90d. to the leaſt Latitude and the ſum or aggregate ſhall be inſtead of its comp: in that operation whereby you enquire the poſition of the greater Latitude from the leſſe. But if the contrary, inſtead of ſubducting the firſt arch from the com:of the greater latitude ſubſtract it from the aggregate of the greater latitude and 90d. Thus the poſition of the Cape of good hope from the Iſle of *May* (being one of the Iſlands of *Cap verde*) is found S. E. by E. 6d. eaſterly. But of the Iſle of *May* from the Cape of Good-hope *N W*. by *W*. 5d. 21 m. weſterly. It being preſuppoſed that the Iſle of *May* hath 15 deg. North Latitude, The Cape of good hope 38d. of ſouth Latitude, and difference of Longitude 50d. Here I might proceed to ſhew by what Longitudes and Latitudes the arch of a great Circle paſſeth, and how far to ſaile ere you vary your courſe, with many other varieties incident to Navigation, which I have here but lightly touched, not intending to wade through every caſe that might be propounded. Being well aſſured that what I have already done is to little purpoſe, unleſſe thou art ſomewhat converſant in *Trigonometrie*, wherefore if thou wilt acquire perfection in this, or any other the Mathematicall Sciences, let it be thy ſtudy to be well grounded in the Doctrine of Triangles till then, things that are in themſelves very fecible, will ſeeme to thee moſt profound. But as to that *pedem figo*, and conclude in the words of *Francis Vieta*. *Ex Angulis Latera vel ex Lateribus Angulos et mixtim, in Triangulis tam planis quàm Sphæricis, aſſequi, Summa gloria Mathematici eſt: Sic enim Cælum, et Terras et Maria felici et admirando calculo menſurat*. To which, not unfitly we may conjoyne that of the Learned *Alſted*, *Trigonometria cyclometrica habet uſum non ſolùm in geodæſiâ, ſed etiam in ſupputandis motibus cæleſtibus, eclipſibus diſtantiis locorum, fabricandis ſciatericis, et extruendis ædificiis: ac proinde per univerſam Matheſin ſpargitur*.

*Non nobis, Domine, non nobis, ſed Nomini tuo detur Gloria.*

FINIS.

## *A Table ſhewing the 32 Rumbs or Winds of the Compaſſe, with their reſpective degrees from the North point, here added for the exerciſe of every Learner.*

| Firſt Quarter between the North and the Eaſt. | | | Second Quarter between the Eaſt and the South. | | | Third Quarter between the South and the Weſt. | | | Fourth Quarter between the Weſt and the North. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Rumbs* | D. | M. | *Rumbs* | D. | M. | *Rumbs* | D. | M. | *Rumbs* | D. | M. |
| N | 360 | 00 | E | 90 | 00 | *S* | 183 | 00 | W | 270 | 0 |
| N by E | 11 | 15 | E by *S* | 101 | 15 | *S* by W | 191 | 15 | W by N | 181 | 15 |
| N N E | 22 | 30 | E *S* E | 112 | 30 | *S S* W | 202 | 30 | W N W | 292 | 30 |
| N E by N | 33 | 45 | *S* E by E | 123 | 45 | *S* W by *S* | 213 | 45 | NW by W | 303 | 45 |
| N E | 45 | 00 | *S* E | 135 | 00 | *S* W | 225 | 00 | N W | 315 | 00 |
| NE by E | 56 | 15 | *S* E by *S* | 146 | 15 | *S*W by W | 236 | 15 | NW by N | 326 | 15 |
| E N E | 67 | 30 | *S S* E | 157 | 30 | W *S* W | 247 | 30 | N N W | 337 | 30 |
| E by N | 78 | 45 | *S* by E | 168 | 45 | W by *S* | 258 | 45 | N by W | 348 | 45 |

## *A Catalogue of ſome of the moſt eminent Cities and Regions in the World, with their Longitude and Latitude and temporary diſtance of their Meridians from London.*

| Names of Places. | Longi. | | Latit. | | Diff. Meri. | | |
|---|---|---|---|---|---|---|---|
| | D. | M. | D. | M. | H. | M. | |
| *London* | 21 | 00 | 51 | 32 | 00 | 00 | |
| *Aberdene* in *Scotland* | 18 | 50 | 58 | 35 | 00 | 9 | *S* |
| *Alexandria* in *Egypt* | 60 | 30 | 30 | 58 | 2 | 38 | A |
| *Amſterdam* in *Holland* | 26 | 00 | 52 | 24 | 0 | 20 | A |
| *Athens* in *Greece* | 48 | 30 | 37 | 42 | 1 | 50 | A |
| *Babilon* in *Caldea* | 76 | 00 | 35 | 00 | 3 | 40 | A |
| *Barbadas*, an Iſland | 320 | 00 | 13 | 00 | 4 | 4 | S |
| *Carthage* in *Africa* | 31 | 15 | 34 | 50 | 00 | 41 | A |
| *Conſtantinople* | 55 | 30 | 43 | 5 | 2 | 18 | A |
| *Copenhage* in *Denmarke* | 33 | 30 | 55 | 43 | 0 | 05 | A |
| *Damaſcus* in *Syria* | 70 | 00 | 34 | 00 | 3 | 16 | A |
| *Dantzick* | 10 | 35 | 54 | 23 | 1 | 18 | A |
| *Dublin* in *Ireland* | 12 | 45 | 54 | 40 | 0 | 33 | *S* |
| *Elſe*-Nore in *Denmark* | 34 | 33 | 57 | 00 | 0 | 54 | A |

*Florence*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Florence in Italy | 39 | 10 | 43 | 40 | 1 | 13 | A |
| Farnambuck in Braſil | 349 | 40 | 9 | 20 | 2 | 5 | S |
| *Geneva* | 28 | 0 | 45 | 54 | 0 | 28 | A |
| *Granada Nova* | 315 | 25 | 11 | 10 | 4 | 2 | S |
| *Hieruſalem* | 66 | 15 | 32 | 10 | 3 | 0 | A |
| *Havana* in the Iſle of *Cuba* | 300 | 0 | 23 | 00 | 5 | 24 | S |
| *Ingolſtade* | 32 | 45 | 48 | 42 | 0 | 47 | A |
| *James* City in *Virginia* | 303 | 30 | 37 | 30 | 5 | 10 | S |
| *Ligorn* | 38 | 20 | 43 | 30 | 1 | 8 | A |
| Lysbone in *Portugall* | 12 | 5 | 39 | 38 | 0 | 36 | S |
| Lyzard in the Weſt of *England* | 14 | 30 | 50 | 10 | 0 | 26 | S |
| *Madrid* ſeat of the K. of *Spain* | 18 | 15 | 40 | 45 | 0 | 11 | S |
| *Mexico* | 278 | 30 | 20 | 6 | 6 | 50 | S |
| *Middleburg* in *Zealand* | 26 | 0 | 51 | 30 | 0 | 20 | A |
| *Naples* in Italy | 36 | 10 | 40 | 42 | 1 | 1 | A |
| *Paris* in *France* | 23 | 30 | 48 | 51 | 0 | 10 | A |
| *Prague* in *Bohemia* | 35 | 20 | 50 | 6 | 0 | 57 | A |
| *Quinſay* the greateſt City in the World | 193 | 0 | 37 | 40 | 11 | 28 | A |
| *Rappahanock* in *Virginia*, *ſedes Autho.* | 303 | 30 | 38 | 30 | 5 | 10 | S |
| *Rome* in *Italy* | 36 | 36 | 42 | 2 | 1 | 2 | A |
| *Stockholm* in *Swethland* | 36 | 14 | 58 | 50 | 1 | 1 | A |
| *Syracuſa* in *Sicily* | 37 | 30 | 36 | 50 | 1 | 6 | A |
| *Plymmouth* in New-*England* | 311 | 30 | 42 | 15 | 4 | 38 | S |
| *Tubing* | 30 | 35 | 48 | 34 | 0 | 38 | A |
| *Vienna* in *Auſtria* | 37 | 20 | 48 | 22 | 1 | 5 | A |
| *Venice* | 36 | 15 | 15 | 15 | 1 | 1 | A |
| *Wittenburgh* in *Saxony* | 34 | 0 | 51 | 52 | 0 | 53 | A |

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# FINIS.

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## Courteous Reader,

Before thou perusest the Book, [illegible] with thy pen to correct the mistakes [illegible] according to the direction of these [illegible] So shalt thou do right to thy se[illegible] the absent Author, who hath [illegible] about himself for thy benefit [illegible] In the like case thou wouldst [illegible]

Errata.

In the Book. p. 2. l. 6. r. insinuated. l. 13. r. exceeded & fire [illegible] p. 3. l. 23 r. forementioned and Roma, Syllas p. 4 l. 2 r. A- [illegible] gainst, 3rd for a period [illegible] between this and [illegible] according, insert according to his equall motion. Unequally [illegible] l. 10. r. figures. p. 7 l. 10 r. is the tropicall [illegible] p. 12 l. 8 r. [illegible] and untill, r. and so on untill. l. 24. r. [illegible] for 6. 7. 9 p. 16 l. [illegible] edge, p. 15 l. [illegible] vulgarly l. [illegible] it is called. l. 23 [illegible] in the end p. 47 l. [illegible] vertue.

*Courteous* READER,

Before thou peruſeſt the Book, be pleaſed with thy pen to correct the miſtakes of the Preſſe, according to the direction of the *Errata* following; So ſhalt thou do unto thy ſelfe a pleaſure, and to the abſent *Author*, who hath freely herein laid out himſelfe for thy behoofe, that right, which in the like caſe, thou wouldſt wiſh might be done unto thee.

IN the Table, Epiſtle, and Encomiaſtick verſes. p 1. l. 31. read Propoſitions. p. 2. l. 8. r change. p. 4 l. 3. r paradox. p. 5. l. 9 r occultantia. l. 13. r. arctis. p. 6. between the 7. & 8. line, inſert this verſe *Within the Circle of a little Globe.* p. 7. l. 3 r. reſcire. l. 5. r. ſit & poſthæc. l. 9. r. vollumine. l. 15. r. modularier. l. 11. r. tum & aptatis l. 14. r. perluſtreris. p 8 l. 13 r. vellent. l 18. r. intatis. l. 19. r. qualeſcunq; l. 20. r. *adſcribi.*

In the Book. p. 2. l. 6. r. inſtituted. l 13. r. receded & ſite p. 3. l. 13 r. forementioned and *Novus Stylus* p. 4 l. 2 r. Againe, and ſet a period at Lunarie. p. 4. l. 5. between this and according. inſert according to his equall motion Unequall. l. 10. r. ſignes. p. 7 l. 19 r. is the *terminus à quo* p 12. l. 8. for and untill, r. and ſo on untill. l 24. for and r. if. p 14. l 13. for 6. r. 9 p. 16. l 23. r. adde. p 17. l. 9. r. is vulgarly. l. 14. r. it is called. l 23. r. divide, p. 34 l. 13 r. in the end. p. 47. l 13. r. veritie.